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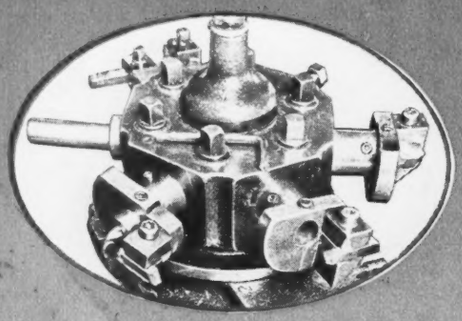

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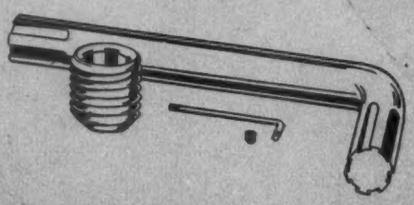

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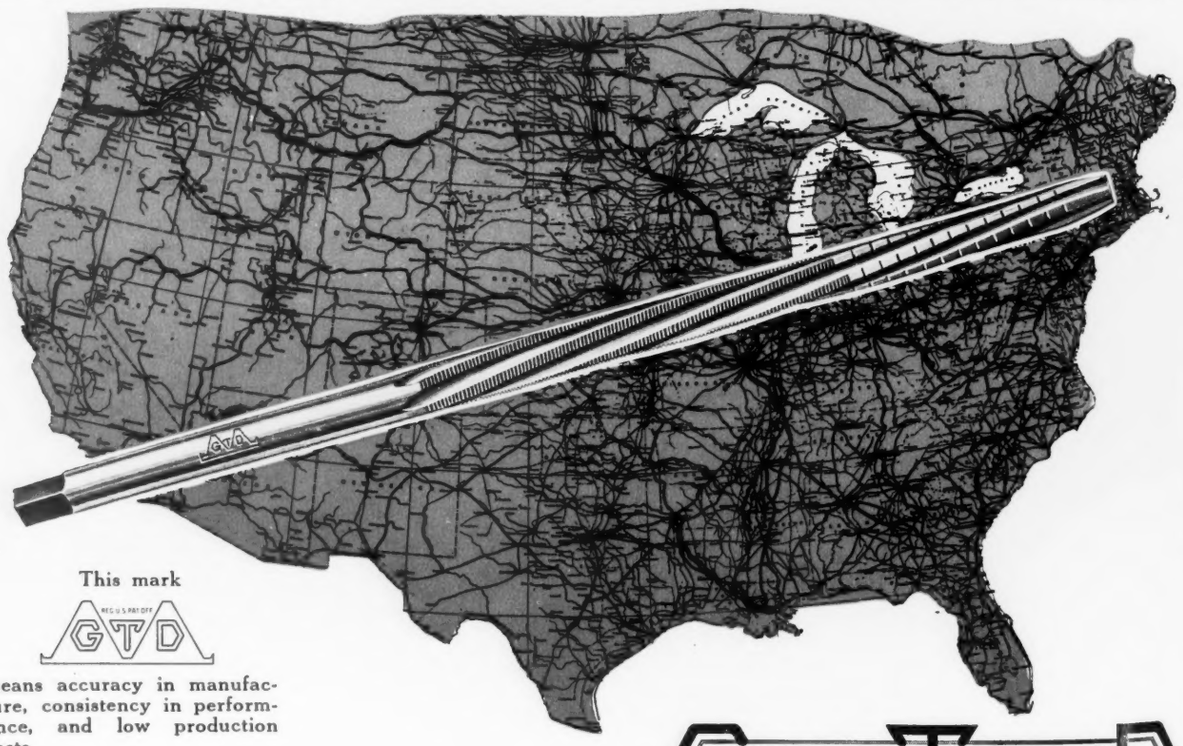

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Special Tools for Railway Shops

Tools and Machines Selected by Experienced Railway Shop Superintendents and Foremen as the Best Examples of Efficient Special Equipment

IN locomotive repair shops many special tools are used to reduce the amount of time and labor required for different operations. These special devices, in many instances, also result in improving the quality of the work. If it were possible for superintendents and foremen in railway shops to visit numerous other shops throughout the country, they doubtless would be interested principally in these special tools and appliances, because many of them are of considerable value to those responsible for results. Since very few shop executives ever have the opportunity of visiting repair shops on various railroads in order to obtain new ideas and discuss different methods, MACHINERY has secured directly from representative shop superintendents and foremen on different eastern and western railroads, information about some very unusual and efficient special tools and machines.

These devices have been submitted to MACHINERY because they have proved, in the shops where they were originated, to be exceptionally valuable in connection with different branches of repair work. A number of these developments are illustrated and described in the following pages, and others will be presented in succeeding numbers of MACHINERY. In reading about the different appliances described, it will be noted that special efforts have been made by their designers to simplify the construction as far as possible and to utilize commercial equipment whenever practicable. For instance, standard air motors have been used for driving several of the machines to be described, and standard or stock materials, such as structural shapes, pipes, tubes, etc., have been used in the designs wherever feasible, thus greatly reducing the initial cost and making it possible for other shop executives to build similar devices without difficulty. It is believed that the large reductions in repair costs obtained with many of these tools can be duplicated in other shops, provided similar tools or designs operating on the same general principles are constructed.

REBORING AIR PUMP CYLINDERS

A machine designed for the special purpose of reboring the cylinders of Westinghouse air pumps has resulted in reducing the time from 8 or 9 hours to about 2 1/2 hours. This machine is used in the air brake repair department. Fig. 1 shows the machine with a cross-compound air pump in position for boring, and Fig. 2 shows the machine without the work in position.

Before the installation of this machine, the air pump cylinder reboring was done either on a horizontal or a vertical boring mill—machines costing from $6000 to $8000. Each cylinder was bored separately, and the time per pump varied from 8 to 9 hours, not counting the extra time spent in moving the pumps to and from the Air Brake Repair Department. Now the air brake repair men, by using the special machine to be described, do the air pump reboring themselves. All four cylinders of a cross-compound pump can be bored simultaneously or a single cylinder can be bored if desired. The time required to

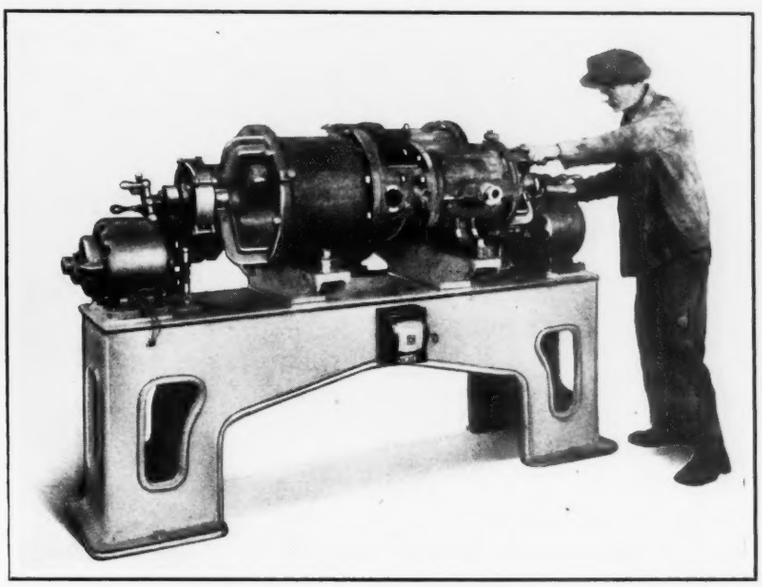


Fig. 1. Special Air Pump Cylinder-boring Machine with Pump in Position for boring

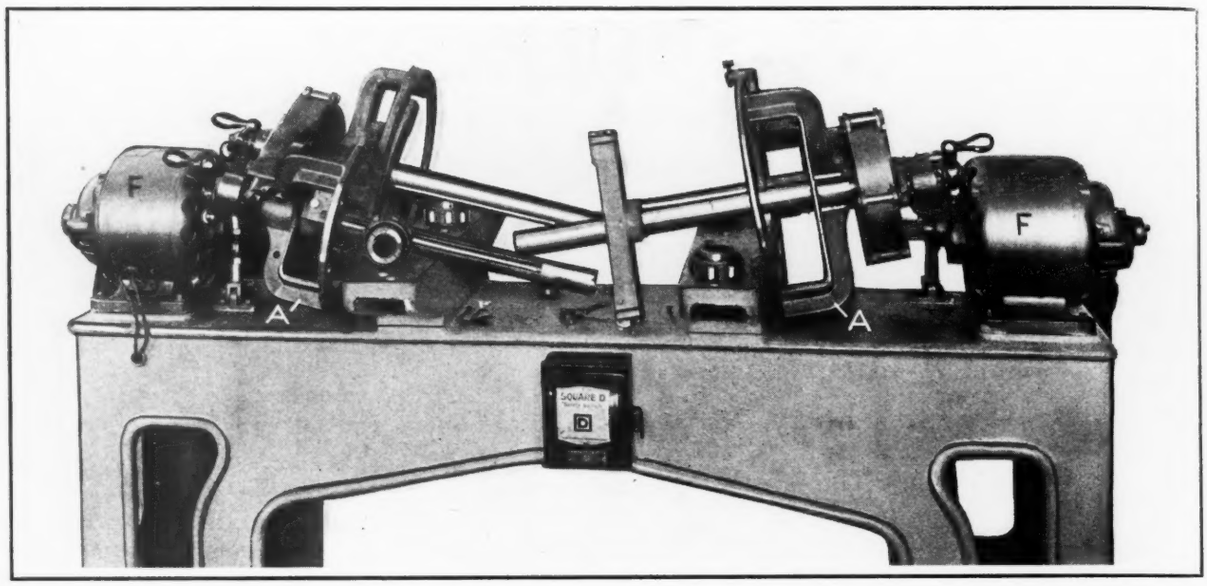


Fig. 2. View of Air Pump Cylinder-boring Machine after Removal of Work; the Boring-bar Units shown are supported and aligned by the Cylinders to be bored

rebore all four cylinders varies from 2 hours and 20 minutes to about 3 hours. This range of time was taken from the actual floor-to-floor time records kept for over one year.

An idea of the general arrangement of this machine may be obtained by referring to Fig. 2 in conjunction with the plan view, Fig. 3, the latter showing a sectional view of a cross-compound pump in the boring position. The boring units, after being placed in position and adjusted, are fastened securely at the outer ends of the cylinders. Each pair of cylinders is bored by one of these units which consists of two bars supported at the outer ends by a frame *A* attached to the cylinder flanges. The boring-bar bearings in frame *A* have the same center-to-center distance as the pumps when new, thus assuring a continuance of this original dimension. The inner ends of the bars are held central by making use of the air pump stuffing-boxes, as shown in Fig. 3, and also in the detail view, Fig. 4. These stuffing-boxes are first cleaned thoroughly by using a special reamer. This is important, the purpose of reaming being to remove any dirt that might prevent the bars from being located in the center of the stuffing-boxes.

Referring now to Fig. 4, the end of the bar *B* is supported by bushing *C*, which is split lengthwise in four places to permit contraction. This bushing is slightly tapered on the outside, and a standard packing nut *D* is used to adjust it so as to eliminate all play between it and the bar. In nut *D* there are clearance holes for the screws connecting *D* and *C*, which permit split bushing *C* to float slightly in case the threaded portion is not exactly concentric with the stuffing-box bore.

These boring-bars originally were made in one piece, or long enough to pass through both steam and air cylinders, but now they are joined at the center by slip couplings, as shown at *E*, Fig. 3. These couplings are of the well-known Oldham type. The coupling connection at the center does not affect the alignment of the rebored cylinders in any way, but it does facilitate the removal of the cutter-heads after the work is completed.

The outer ends of the bars are set central with the old counterbore by using a tool in the holder and adjusting the frame *A* until the tool indicates that the bar has been properly centered. This adjustment is obtained by means of four thumb-screws which permit the frame to be shifted. After the bars have been centered, the frame is tightened by using the cylinder studs which pass through holes in the frame.

Double-ended cutter-heads are used in each cylinder, there being two cutters in each head located diametrically opposite each other. The cutters are mounted in adjustable blocks, and the tools are ground to a templet, so that a smoothly finished bore is always obtained. Each pair of boring-bars is driven by a 1 1/2-horsepower motor *F*, and each motor drives two bars through a train of spur gearing. The cutter-heads are fed along the revolving bar by a feed-screw located within the bar and revolved by planetary gearing at the end. This feed-screw and its cutter-head have independent adjustment obtained by turning ball-crank handles located at the

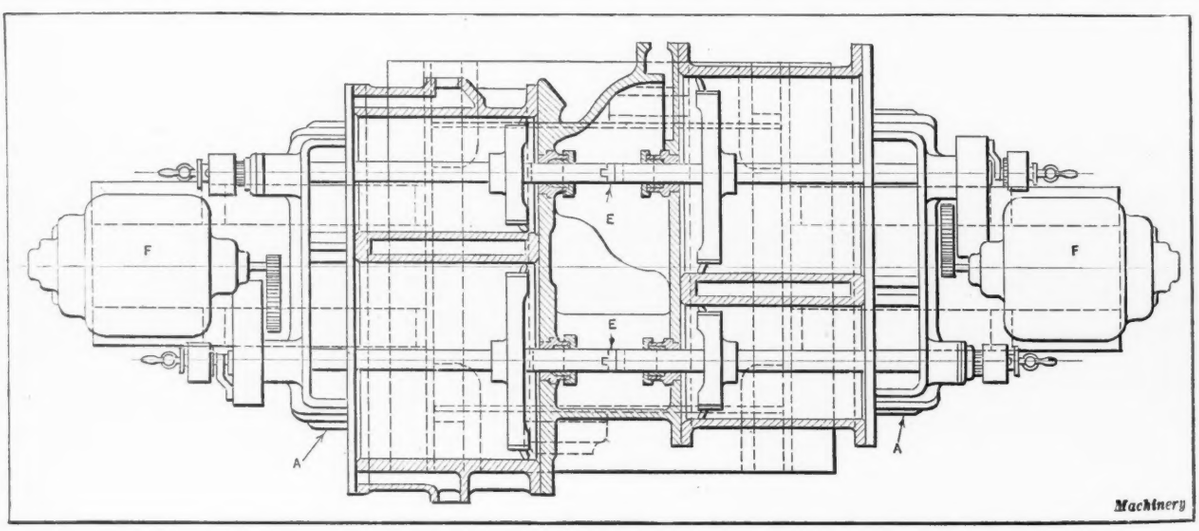


Fig. 3. Plan View of Cylinder-boring Machine with Pump shown in Section to illustrate how Boring-bar Units are supported

outer ends. The cutter-heads make 18 revolutions per minute, and a feed of about 0.030 inch per revolution is used.

The average cost of current used by the two 1 1/2-horsepower motors for boring all four cylinders of a compound pump is less than 2 cents, with current at 2 cents per kilowatt-hour. This cost was determined by using an Esterline meter, and it is checked frequently. In reboring a pump, one cut usually is sufficient, and the actual cutting time for the bores and counterbores is less than one hour, as shown by the following conservative time study of the various operations connected with the reboring of a cross-compound Westinghouse air pump.

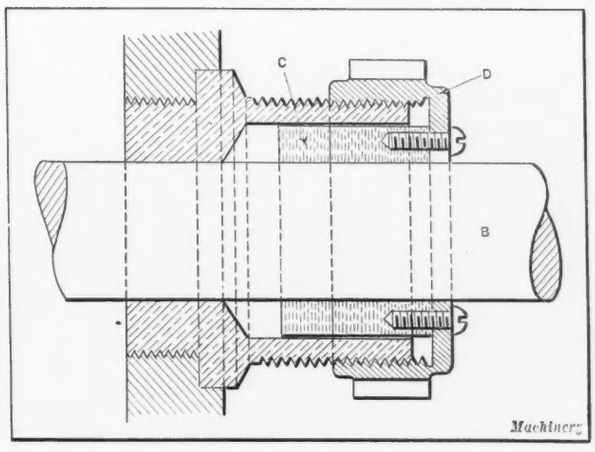


Fig. 4. Detail of Split Bushing used in Air Pump Stuffing-boxes to hold Boring-bar in Accurate Alignment

1. Setting pump on stand and bolting it..... 7 minutes
2. Cleaning four stuffing-boxes.....11 minutes
3. Placing four boring-bars in position, and setting tools to correct diameter.....70 minutes
4. Boring all cylinders.....27 minutes
5. Counterboring all cylinders.....25 minutes
6. Removing boring heads and placing pump on floor .....18 minutes

Total.....2 hours 38 minutes

The foregoing includes the use of a helper for 15 minutes. In reboring cylinders, it is the practice in some shops to separate the cylinders and rebore them either in a lathe or boring mill. This method usually makes it necessary to supply a new gasket (costing $1.80), and probably 2 hours extra time will be required for dismantling and reassembling the cylinders; in addition, there is always danger of lack of alignment between the reassembled pump cylinders which have been bored separately. This special machine which has been described bores the cylinders much more satisfactorily than the lathe or boring mill method, and also in much less time and with a minimum of handling.

AUXILIARY BORING-BAR FOR AIR PUMP CYLINDERS

By E. A. MURRAY, Shop Superintendent
The Chesapeake and Ohio Railway Co.

The attachment to be described is applicable to a horizontal boring machine, and it is used for reboring worn compound air pump cylinders. It consists of an auxiliary boring-bar *A* (Fig. 5), which is parallel with the main boring-bar. The auxiliary bar carries a spur gear *B*, which meshes with a flanged or shrouded gear *C* on the main bar. By this simple arrangement, the auxiliary bar is revolved and at the same time is given a horizontal feeding motion. This feeding movement is caused by the flanged gear *C* which carries gear *B* along with it as the main boring-bar advances. These steel gears each have 55 teeth of 4 diametral pitch. The auxiliary boring-bar is 4 inches in diameter, and is mounted in brass bearings adjustable to compensate for wear. The air pump cylinders to be bored are bolted to an angle-plate, which is attached to the machine table and holds the cylinders in the correct position. By boring both cylinders simultaneously, the time for this operation has been reduced at least 50 per cent.

AIR PRESSURE BOOSTER

By E. A. MURRAY, Shop Superintendent
The Chesapeake and Ohio Railway Co.

On account of the air pressure in the shop air lines being low, it has been found that if a booster is used for increasing the air pressure at the point where pneumatic tools are being used, the efficiency of such tools is increased to a noticeable extent. A booster designed for use in the shops of the Chesapeake and Ohio Railway Co. at Huntington, W. Va., is shown in Fig. 6. Usually an air pressure of 100 pounds per square inch is available, but this has been found insufficient, especially when doing heavy riveting and tapping; hence, it has been found that by using the booster, the air pressure can be increased, materially increasing the efficiency of the pneumatic tools.

The booster consists of a standard 9 1/2-inch Westinghouse air pump, a reservoir of the dimensions indicated in the illustration, a Westinghouse governor, and a four-wheeled truck, thus making the outfit portable. The shop air line is connected at the air inlet *A*, and outlet *B* is connected to the air reservoir. The pump is controlled by a one-inch standard Westinghouse pump governor *D* set at 120 pounds per square inch. The pressure in the tank is protected by a safety valve *E* set at 140 pounds pressure per square inch. At *F* there is a fitting arranged for three hose couplings to

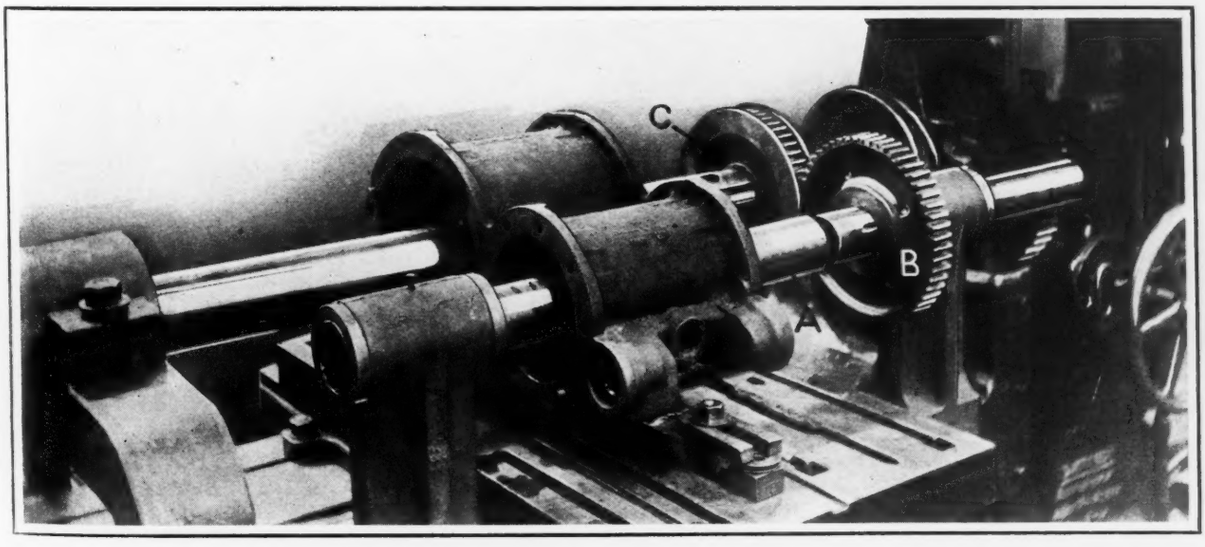


Fig. 5. Auxiliary Boring-bar used on a Horizontal Boring Machine for boring Two Compound Air Pump Cylinders at the Same Time

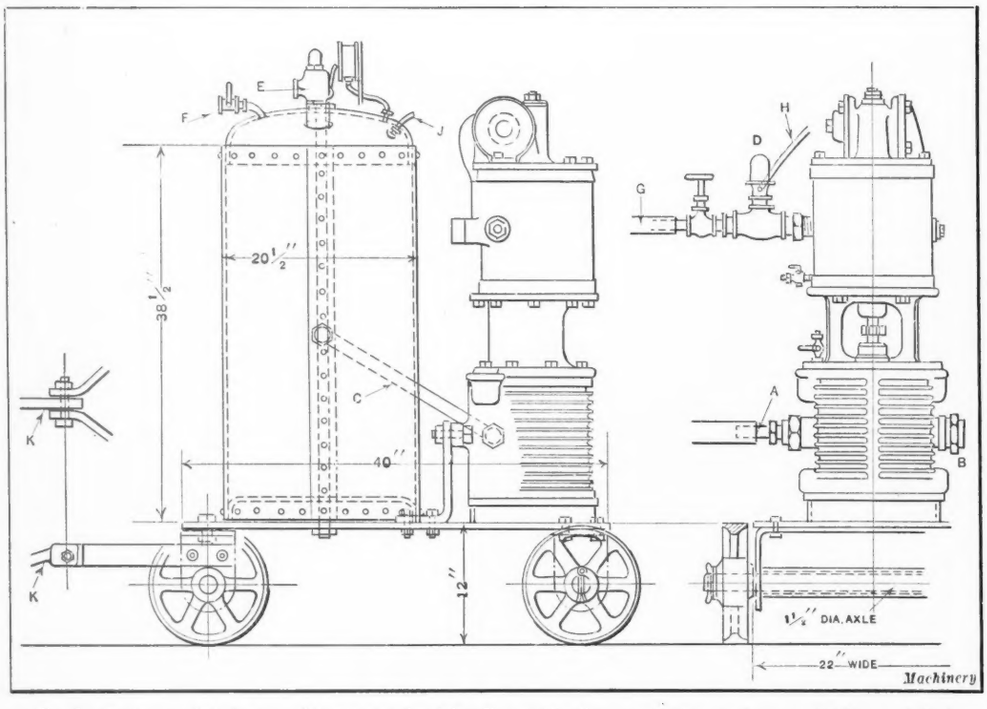


Fig. 6. Booster used to increase Air Pressure for doing Heavy Riveting or Tapping, to increase Efficiency of Tools

be used when one or more tools are in use at the same time. Air is admitted at *G* for driving the pump. The tank is, of course, provided with an air gage. The tank is held in position by a 1 1/4-inch rod which passes through the center of the tank and reinforces the heads of the reservoirs, making a suitable fastening for the reservoir. A tongue-shaped handle 36 inches long is connected at *K* to provide a convenient means of pulling the truck from one place to another.

NUT-DRIVING MACHINE

RADIAL AIR-DRIVEN TYPE FOR TIGHTENING NUTS ON TANK TRUCKS OR REMOVING THEM

The operation of tightening nuts on tank trucks or removing them is not only a laborious task when performed with hand wrenches, but also requires strong men. By the use of the machine shown in Figs. 7 and 8, one man, who need not have even average strength, can perform the work of two men using wrenches, in one-quarter of the time ordinarily required by hand labor.

A standard or commercial air motor is used for revolving the spindle, which is equipped at its lower end with a socket wrench for either tightening or removing nuts. This wrench spindle, with its air motor and gearbox, is mounted on a radial arm 16 feet long. The arm swings horizontally like the arm of a radial drilling machine. It is made of two 8- by 2 1/4-inch channel irons *A* (see Fig. 8 including the detail view in the upper right-hand corner). The vertical column consists of two old superheater flues *B*, and a 3 1/2- by 15-inch channel iron *C*. The outer end of the arm is supported by a 1-inch tie-rod *D* equipped with a turnbuckle.

The spindle head, with its motor, is provided with two rollers *E* on each side (see detail view), so that it can readily be moved along the arm. This adjustment, in addition to the swinging movement of the arm, makes it possible to locate the wrench spindle readily over different nuts on the truck. The socket wrench *F* is removable, so that the proper size can readily be attached to the spindle. The rapid-acting socket lift lever *G* (see detail view) is used to raise or lower the socket wrench quickly, either for engaging with the nut or disengaging.

The pneumatic motor *H* operates the spindle through a two-speed transmission, which is controlled by lever *J* connecting with clutch *K*. When the clutch is in the position shown, the slow-speed drive for nut tightening is obtained. The drive is to pinion *L* (23 teeth), gear *M* (98 teeth), pinion *N* (25 teeth) and gear *O* (96 teeth). When clutch

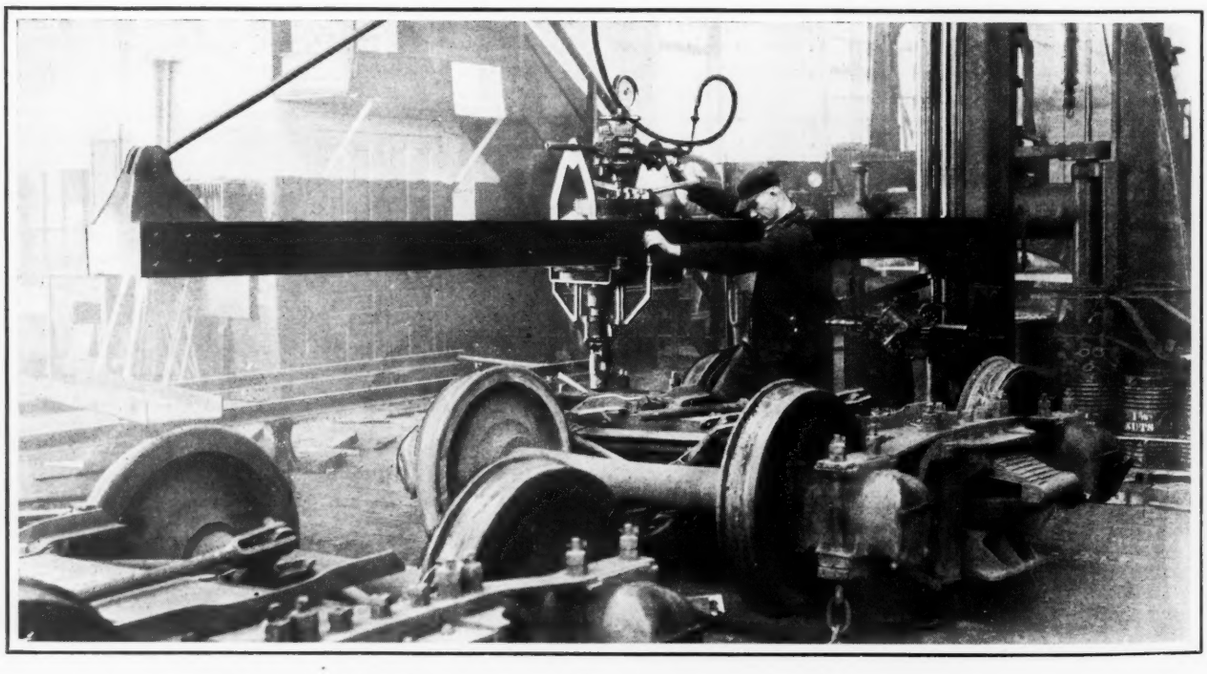


Fig. 7. Air-driven Nut-driving Machine for tightening Nuts on Tank Trucks or removing them

K is in engagement with gear *P* (77 teeth) for obtaining the fast speed, the drive is to gear *Q* (44 teeth) and then to pinion *N* and gear *O*. This fast speed is used for running the nuts on or off, and the tightening or loosening requires the more powerful slow speed. All of these gears are 8 diametral pitch.

All nuts from the 1-inch to the 1 3/4-inch sizes are handled with equal facility. In fact, a 1 3/4-inch nut tightened by this machine is as tight as two men can pull it with a 4-foot socket wrench. It would be possible to break the bolts with this machine, but to prevent this, a Westinghouse reducing valve is used in the air pipe line connecting with the motor. A graduated dial *B* is attached to the adjusting handle of this valve, as shown by the detail view, Fig. 9. The graduations on this dial indicate the sizes of nuts, and the dial is turned until the size to be tightened is opposite pointer *A*. These graduations have been located by actual tests in tightening different nut sizes the desired amount. For example, if the dial is set opposite 1 1/2, this means that a nut of that size will automatically be tightened the proper amount, as determined by actual trial.

The required air pressures, in pounds per square inch, for tightening different nut sizes have been found to be as follows: 1-inch nuts, 40 pounds; 1 1/4-inch nuts, 50 pounds; 1 1/2-inch nuts, 60 pounds; and 1 3/4-inch nuts, 70 pounds per square inch. For loosening nuts, the full shop air pressure of 100 pounds per square inch is employed.

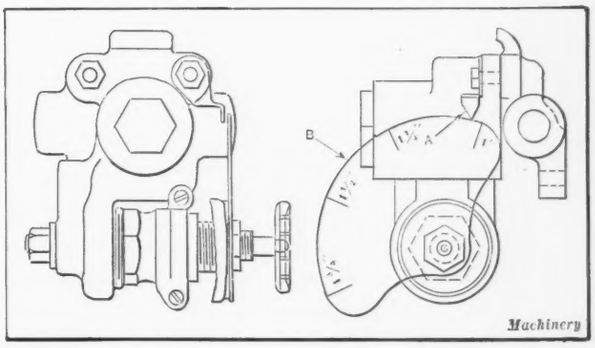


Fig. 9. Valve which regulates Air Pressure to suit Nut Sizes

The pneumatic motor seen at the right in Fig. 7 and at *R* in Fig. 8 is used for raising or lowering the radial arm to suit the heights of different trucks. This feature can be dispensed with if all trucks are practically uniform in height. The pneumatic nut-driving machine described has made it

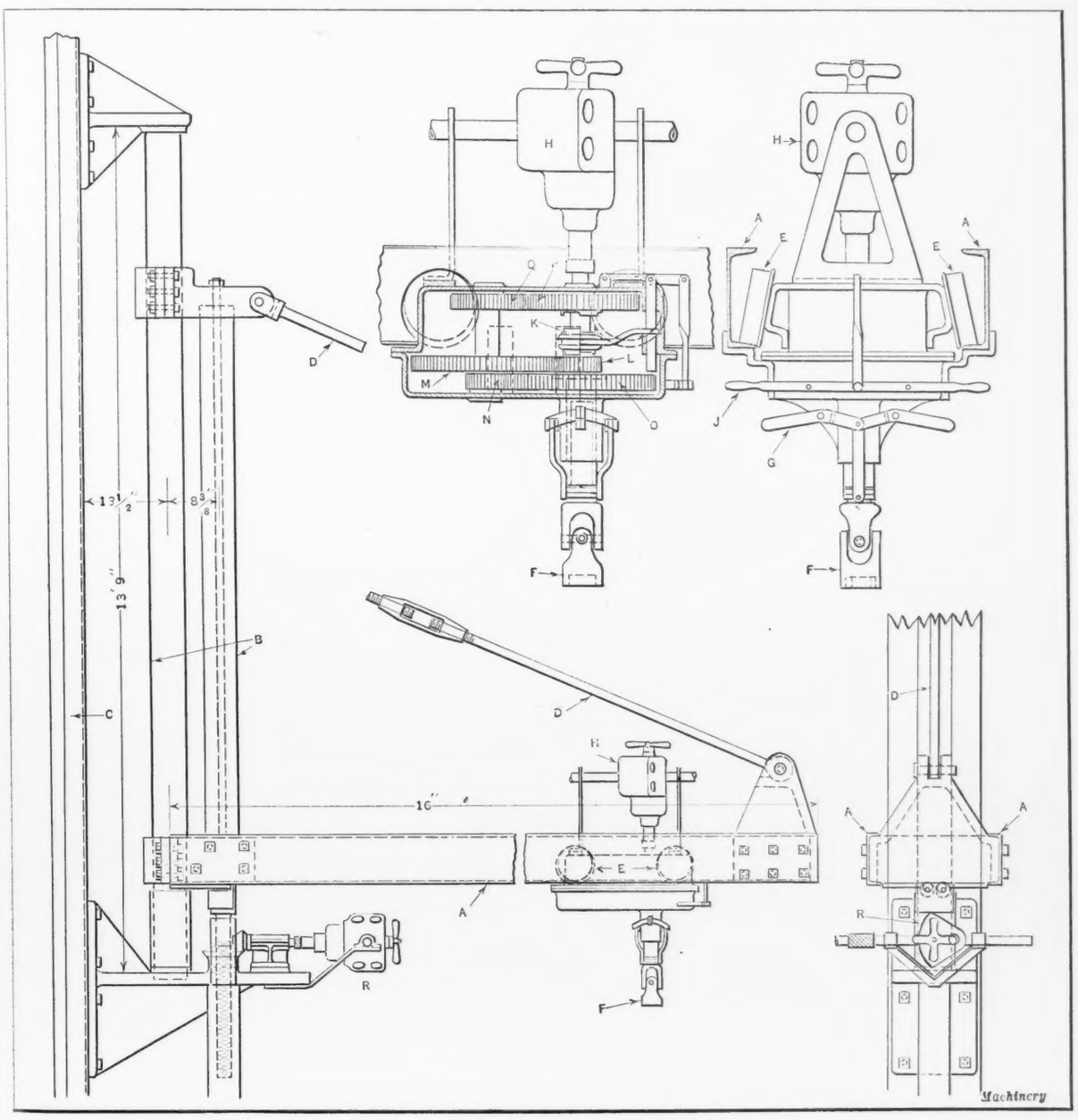


Fig. 8. Detail of Column, Arm, and Two-speed Driving Mechanism of Nut-driving Machine

possible to eliminate a slow, costly, undesirable job requiring two strong men. With this machine, a light man can perform the work easily and efficiently, and it is a pleasure to watch the machine in operation.

GAGE FOR SETTING BLADES IN FLUE-HOLE CUTTER

By J. R. PHELPS
Atchison, Topeka & Santa Fe Shops, San Bernardino, Cal.

In setting the blades in a superheater flue hole cutter, it is important to locate them so that each blade will have the right clearance and be located at the proper radius for cutting a hole of the right diameter. Fig. 10 shows at the left, a flue hole cutter with its two blades in position, and at the right, the gage used in setting these blades. The concentric grooves in the gage correspond to the diameters of the superheater flue sheet holes. These grooves are 1/4 inch wide, and their outside diameters are 4 5/8 inches for the back sheets and 5 5/8 inches for the front sheets. The 1 3/16-inch hole in the center of the gage fits closely over the pilot of the cutter-holder. In order to set the blades in the proper position, the gage is first placed over the pilot of the cutter-holder. The blades are then inserted and clamped so that they coincide with the proper groove and have practically the same amount of clearance on each side.

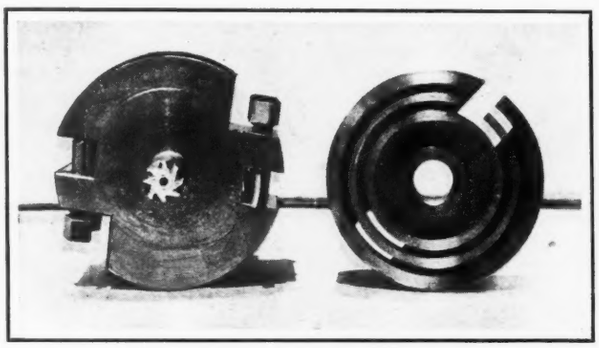


Fig. 10. (Left) Flue-hole Cutter; (Right) Gage for setting Tools

It will be noted that the gage is provided with openings on opposite sides so that the cutters may readily be seen when the gage is in position on the pilot of the cutter-holder. This gage eliminates guesswork and the trial-and-error method, as the blades cut smooth holes of the right diameter at the first setting. In fact, resharpened cutters may be set in the proper position so quickly that the time required for cutting flue holes is reduced proportionately, as indicated by the fact that thirty-eight flue holes in the flue sheet of a Santa Fé type engine, are regularly cut in less than one hour floor-to-floor time.

HOLDER FOR FLUE-HOLE CUTTER BITS

By W. M. HAYES, Missouri Pacific Railroad Co.

The tool-holder shown in Fig. 11 was designed to save time in making duplicate sets of tool bits for cutting superheater flue holes. The cutter bits are used in a holder very similar to the one illustrated, except that the latter has an adjustment for machining the inner and outer sides of the cutters, whereas the actual working holder is designed to hold the cutters in one position only.

The holder used in making a set of cutter bits is held in the lathe by means of the taper shank *F*, which fits the lathe spindle. The illustration shows at the left, a rear view of the holder, at the center, a half section, and at the right, a front view. The four cutter bits in a set, or the blanks from which they are to be made, are held in a like number of cylindrical plugs or holders *A*. Each holder *A* has an arm or crank *B* at its rear end, which is connected by a pin *G* with ring *C*. When turning the bits to form their cutting ends, this ring *C* is held in a fixed position by plug *D*, which enters one of the series of holes *E* in the main body of the tool-holder.

The inner and outer surfaces of a set of bits are first turned with the plug in the central hole, or in the position shown by the rear view at the left. After the bulk of the stock has been removed, plug *D* is withdrawn and ring *C* turned slightly with a spanner wrench. The plug is then placed in another hole, thus locating holders *A* in position for finishing either the inner or outer sides of the tool bits to the proper clearance. One of the plugs *A* is graduated, as shown by the front view, to indicate the number of degrees of clearance equivalent to different positions of ring *C*.

After finishing, say, the outer sides of the cutters, plug *D* is withdrawn again, and ring *C* is turned so that holders *A* are relocated an equal amount on the opposite side of the central position for machining the inner sides of the tool bits. The tools are now ready for service, with the exception of sharpening the ends. The tool bits are held in the slots in plugs *A* by means of screw-operated clamping or chuck jaws, which are inclined to exert a wedging action against the tool bits. This holder makes it possible to machine duplicate sets of cutter bits quickly and with the assurance that each set will be practically the same as regards radius and side clearances.

HOSE-BOLT MACHINERY

By W. M. CAVIN, Foreman, Air Brake Department
Emerson Shops, Atlantic Coast Line

In the air brake department of the Emerson Shops at Rocky Mount, N. C., (Atlantic Coast Line Railroad Co.) more efficient equipment was required for removing old bolts from the large quantities of steam and air hose handled by this department, and applying new ones. The time-saving

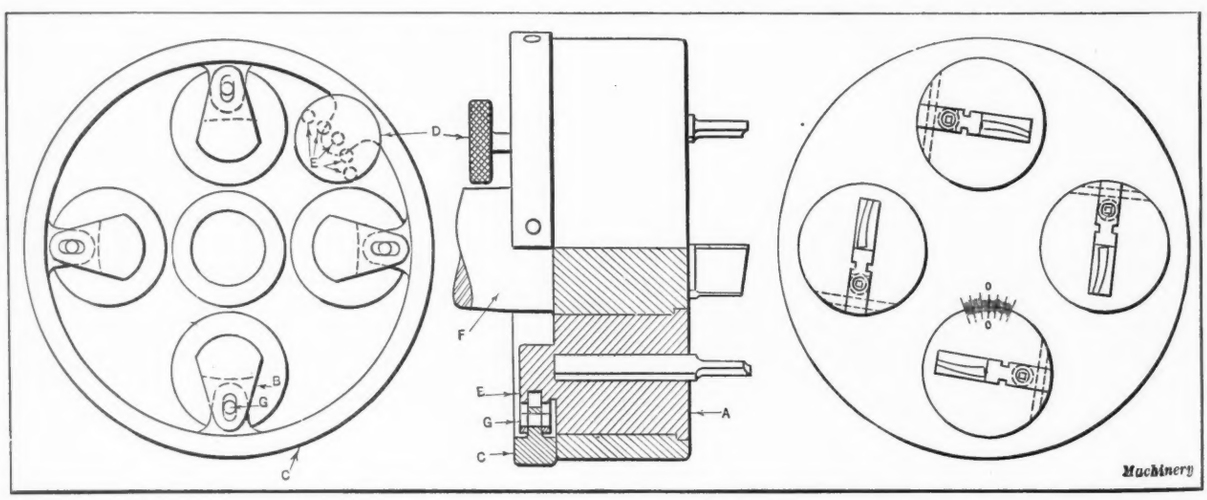


Fig. 11. Tool-holder used in making Duplicate Sets of Tools or Bits for Flue-hole Cutters

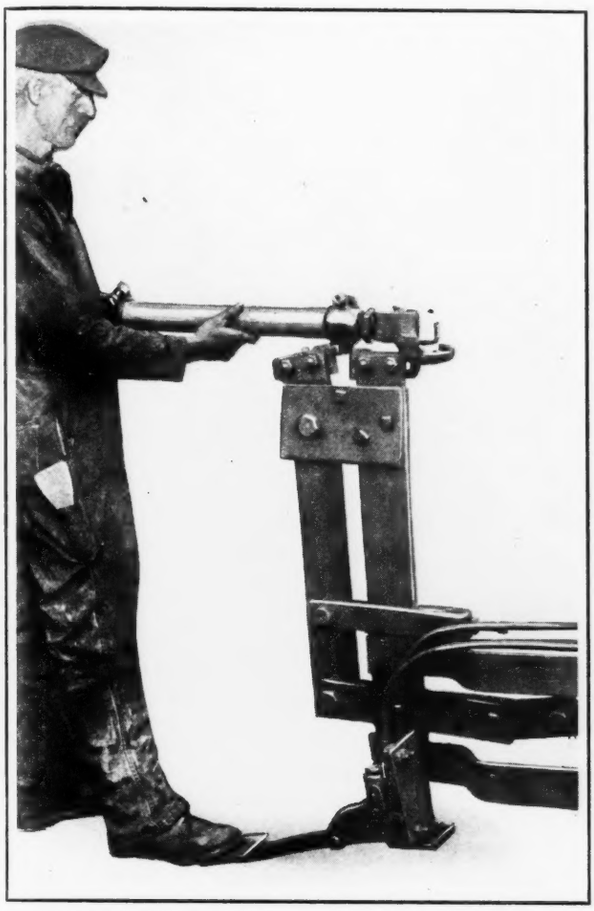


Fig. 12. Bolt Cutter for removing Steam- and Air-hose Bolts

special machinery to be described is the result. This was designed chiefly by Walter L. Parrish, leading mechanic of the air brake department. These machines include a pneumatically operated bolt shear, and clamping and nut-tightening machines which are applicable to both steam and air hose.

Bolt Cutter for Steam- and Air-hose Bolts

Before installing the pneumatically operated bolt cutter shown in Figs. 12 and 13, hand clippers such as are used in a carriage shop were utilized in removing bolts from steam and air hose. Prior to the use of the hand clippers, the bolts were removed from the clamps by hand, the nuts being unscrewed with a wrench. In some instance, this resulted in saving the bolt, but usually the bolt was so corroded and worn as to be unfit for further use. As the amount of steam- and air-hose work increased, it was essential to do this work more rapidly, because the cost of saving bolts exceeded the value of new ones. So at first the hand clipper was resorted to, and later the power-operated bolt cutter was used, which greatly increased the output and decreased the amount of labor required.

With this special machine, a minimum of 480 steam-hose bolts or 600 air-hose bolts may be removed per hour. The air-hose bolts are 1/4 inch in diameter and the steam-hose bolts 1/2 inch, which accounts for the larger output for air-hose bolts. This machine has a fixed blade *A*, Fig. 13, and a movable blade *B*, which are made from flat spring steel 1/4 inch thick. Blade *B* is attached to lever *C*, which is pivoted at *D* and is connected at its lower end by links *E* and *F* with the plunger of an 8- by 7-inch air-brake cylinder *G*. The cutting stroke is regulated by yoke *H*, which has a set-screw to provide adjustment so that the inward movement of blade *B* is stopped at the right point. As Fig. 12 shows, the action of the bolt cutter is controlled by a foot-pedal, so that the operator has both hands free for holding the hose.

As the bolt are cut, the clamps fall off, the good clamps being saved and the bad ones scrapped. The good clamps are dipped into paint and placed on a screen wire to dry. Couplings and nipples are also pulled out of the old hose and painted for future use. This method of removing bolts is at least three times as efficient as the old hand-clipper process.

Steam-hose Clamping and Nut-tightening Machine

After the bolt cutter just described was installed and a new hose stripping and mounting machine had been added to the equipment, it became necessary to find some more rapid means of applying clamps to steam hose so as to keep up with the output of the bolt cutting, stripping, and mounting machines. Consequently, the air-operated machine illustrated in Figs. 14 and 15 was constructed, and has proved very efficient. This machine has an air motor for turning the nut-tightening socket wrench, and an air-operated clamping mechanism controlled by a foot-pedal so that both hands of the operator are free.

In assembling new hose, the nipples and couplings are first inserted by using the mounting machine. The old gaskets are removed, the gasket cavity cleaned, and new gaskets applied. The hose is then piled near a work-bench, where the clamps are placed on the hose by hand. The bolts are also inserted and the nuts started by hand. One bolt is entered from the left side and the other from the right, so that in using the machine it is simply necessary to turn the hose one-half revolution to place the second bolt in position for tightening.

In using this machine, the hose is picked up by the right hand and placed between the concave jaws which fit around the clamp. The operator then presses down on a foot-pedal, admitting air to brake cylinder *A*. Next, jaw *B* moves forward and holds the hose firmly against the fixed jaw, the nut being in line with the socket wrench. This wrench *C*, Fig. 15, is so located that it engages the nut when the hose is placed between the jaws, and it is held in this position by a spring which normally holds it out beyond the working position.

The motor *D* for revolving the socket wrench is of a reversible type, so that it can be used either for tightening or loosening nuts. When the hose is in position, this motor is started by a valve controlled by the left hand of the

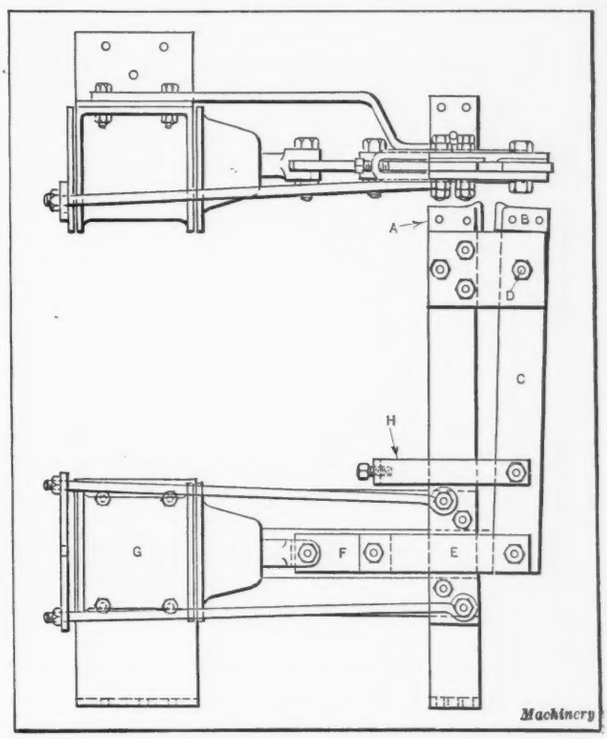


Fig. 13. Side and Plan Views of Bolt Cutter shown in Fig. 12

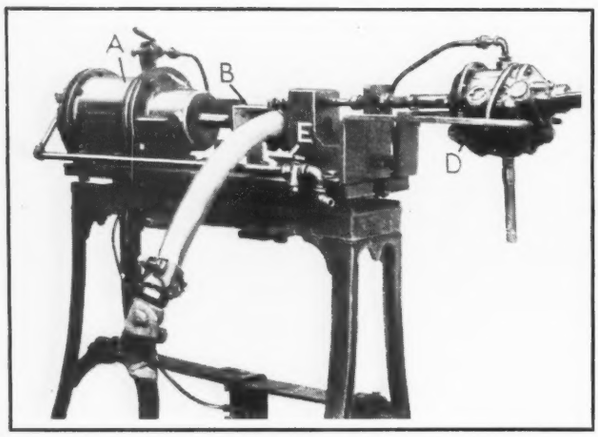


Fig. 14. Steam-hose Clamping and Nut-tightening Machine

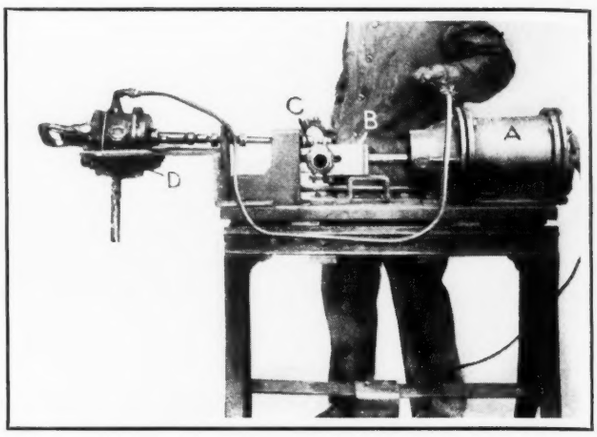


Fig. 15. Rear View of Machine shown in Fig. 14

operator, as shown in Fig. 15. The extent to which the nut may be tightened is governed by a reducing valve located in the air supply line, the plan being to adjust the valve so that the motor will stall when the desired degree of tightness has been obtained. After tightening the first bolt, the hose is turned one-half revolution to locate the second bolt in line with the wrench. These operations are repeated for tightening the clamp on the opposite end of the hose. In releasing the movable jaw, valve *E*, Fig. 14, is opened, so that the spring within the brake cylinder can push the plunger back quickly.

This machine has largely been constructed of spare parts. The frame is the bed of an old lathe, the air cylinder is an 8- by 10-inch brake cylinder, and a Franklin fire-door foot-valve has been used for the foot control. The air motor is of a regular commercial design, and few special parts are required.

Air-hose Clamping and Nut-tightening Machine

After solving the steam-hose clamping problem, a machine for air hose was built. This is shown in Fig. 16. The pivoted clamping jaws *A* are connected by the links *B* to the plunger of a 6- by 10-inch brake cylinder *E*. A Franklin fire-door pedal *C* controls the admission of air to the cylinder, so that both hands of the operator are free. As the plunger moves upward, the hose is clamped in position; the bolt is then inserted, the nut started by hand, and tightened by a small crank-operated socket wrench *D*. An average of 60 air hose per hour may be clamped in this machine, which is more than three times the output formerly obtained by hand work, using a special air-operated vise. An attempt was made to use an air motor for tightening these nuts, the same as on the steam-hose machine, but owing to the smallness of the bolts, it was rather difficult to engage the wrench with the nut, so that the small crank wrench was substituted. This machine is very simple and inexpensive, the estimated cost being not over $30, including labor and material.

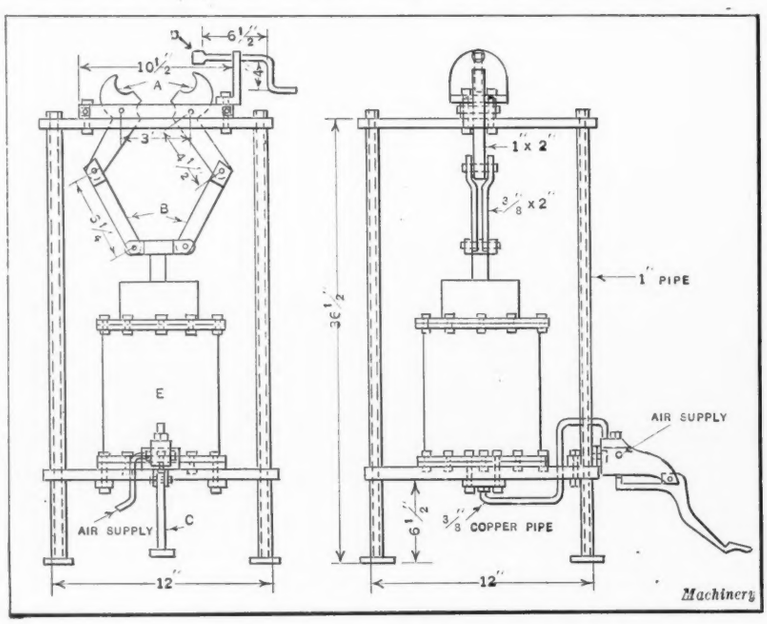


Fig. 16. Air-hose Clamping and Nut-tightening Machine

CHILL-HOLDING FIXTURES FOR TRUCK BOX CASTINGS

By W. A. BACHMAN, Superintendent of Foundries
New York Central Railroad Co.

The engine truck boxes for the heavier modern classes of locomotives are now made of steel castings. Until recently, however, some of these were made of cast iron. All our cast-iron truck boxes were ordered made with a chilled wearing surface for pedestal jaw faces, and with provision for oil cellar clearance. The only shop finish necessary was on the crown bearing and hub liner surfaces.

Our first efforts to cast these were made with loose chills rammed up with the pattern, and resulted in considerable variation in the face-to-face dimensions of the pedestal jaw surfaces and in the oil cellar clearances, necessitating grinding and additional machining. This was due to a variation in shrinkage over the dry sand core, and shifting of the chills due to the strain in pouring the castings and rolling of the molds. We were finally advised that the pedestal jaw faces must not be out of parallel more than 1/32 inch, and were provided with maximum and minimum gages with this tolerance. This resulted in so many rejections at the foundry that we concluded to adopt the practice of maintaining constant alignment of the chills by means of the frame and yoke illustrated in Fig. 17.

Frame *A* is placed on the pattern follow board with the pattern centrally located. Chills *B* are then placed in grooves provided for this purpose, and these chills are secured at the top by means of yoke casting *C*. With this rigid alignment of the chills, the only variable contingent to provide for was the shrinkage of the metal in cooling. The drag portion of the mold is rammed as usual, and rolled. In shaking the casting from the mold, the cope is first stripped and frame *A* removed. The chills are then lightly tapped to remove them from the casting while still at a cherry red heat. It was found that these chills were removed much more readily, and gave

from four to five times the life of those used by the former method. Previously, the chills would shrink with the casting, and considerable labor was required in removing them as the casting cooled, resulting in breakage. By the new method, as the chills are held rigid in the frame and yoke, the casting shrinks away from the chills, so that they practically fall out of the casting when the mold is shaken out.

Experiments to establish proper shrinkage allowance resulted in an unusual change in connection with tie strips *D*, which are intended to secure uniform shrinkage in the oil cellar space. In previous practice, the open end of the truck box would expand when the tie strips were broken from the casting. With the adoption of the new method, the open end would actually contract upon the removal of the core and the breaking of the tie strips. This factor had to be taken into account in determining the shrinkage allowance for the pattern.

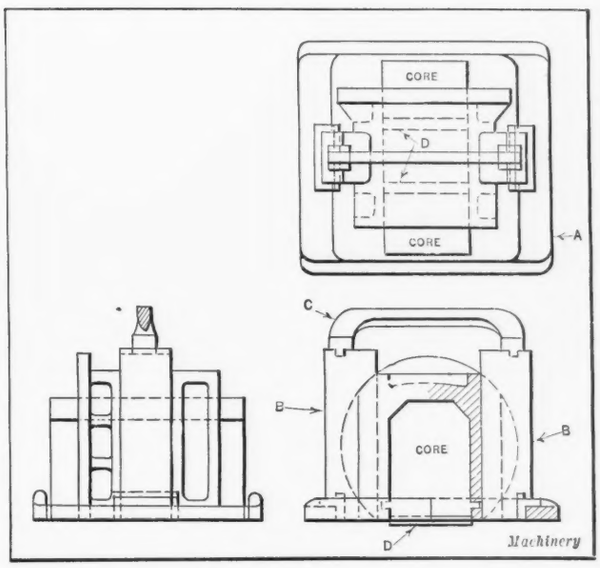


Fig. 17. Fixture for holding Chills in Position while casting Engine Truck Boxes, to produce Accurate Castings

The standardized practice described has been adopted for all cast-iron engine truck boxes, and it has resulted in all castings successfully passing gage tests for parallel alignment of the pedestal jaw faces and clearance for the oil cellars. Unnecessary machine work has been eliminated entirely. Castings are also exceptionally uniform, slight variations being due to differences in the metal mixtures. These variations are, in most cases, less than 1/64-inch. The depth of the chill secured on the pedestal jaw faces, with present mixtures, varies from 5/16 to 1/4 inch, and the quality is such as to permit machining of the journal bearing and hub liner surfaces efficiently.

CUTTING KEYWAYS IN PISTON-RODS

There are various ways of cutting keyways in piston-rods. In some shops, the keyway is formed by drilling a row of holes, and removing the metal between by chipping and filing. This method usually requires 3 hours or more. In other shops, one hole is drilled to provide a clearance space, and the remainder of the slot is cut out on a slotter. This method usually requires about 1 3/4 hours. By the milling method to be described, the total time for cutting a piston-rod keyway is about 25 minutes. Slots have been cut in considerably less time than this, but 25 minutes is considered a satisfactory daily average.

Figs. 18 and 19 show the first and second machining operations in forming a slot by milling. The first step is to drill a hole through the rod, as shown in Fig. 18. This is a 1 1/4-inch hole, and the drill is located centrally and in the right lengthwise position by means of a jig that fits over the tapering end of the piston-rod. The time for this operation is approximately 9 minutes.

The second operation (Fig. 19) consists of placing the cutter in position, adjusting the overhanging arm, and milling a slot 1 1/4 inches wide by 5 inches long. A cutter of the spiral or helical form is used, as it operates with a shearing cut and is very efficient. The time required for performing the second operation is about 13 minutes.

The third and final operation consists in removing the work from the machine and placing it on the floor. This requires about 3 minutes. The milling fixture has a tongue on the under side that fits the groove of the machine table. This tongue is located at an angle so as to give the keyway the correct inclination at the end that bears against the cross-head key.

RECLAIMING AIR-PUMP PISTONS

By W. M. CAVIN, Foreman, Air Brake Department
Emerson Shops, Atlantic Coast Line

In the air brake department of the Emerson Shops of the Atlantic Coast Line Railroad Co., the practice originally was to make new pistons to fit ground air-pump cylinders, as the old pistons were too small to fit the enlarged cylinders. The old pistons soon accumulated to such an extent that they became quite a problem. Some of them were worn in the grooves, but as a rule they were in perfect condition, except for the diameter. An attempt was made to build up these pistons by filling the old grooves, using an oxy-acetylene torch and brass as a filler, after which the pistons were turned on a lathe to fit the cylinder walls, and new grooves cut. It was found, however, impracticable to cut the ring grooves accurately on account of the hardness of the material used in welding. As these air pump piston-rings must fit very accurately, this method of reclaiming the old pistons was modified, with very successful results.

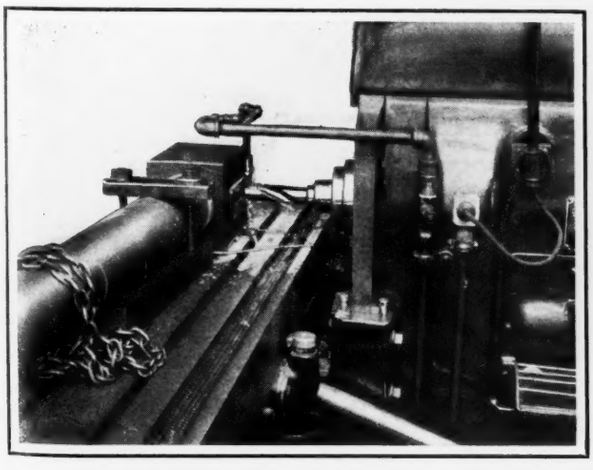


Fig. 18. Drilling a Hole in Piston-rod preparatory to milling Keyway as shown in Fig. 19

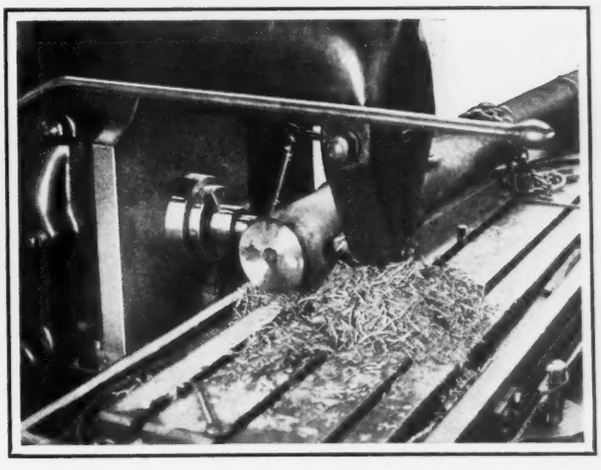


Fig. 19. Milling a Keyway in Piston-rod, using Hole previously drilled as a Starting Point

The old piston, which is represented at *A* in Fig. 20, is first roughed out on a lathe, as indicated at *B*, thus providing a clean new surface to which metal will readily adhere when properly applied by the oxy-acetylene process. Diagram *C* illustrates a piston after the groove has been filled with brass. The piston is enlarged to a diameter of about 8 3/4 inches, thus providing sufficient metal for machining it to fit a cylinder that has been trued by grinding. The next step is to cut a single groove in the center, as illustrated at *D*. This groove is made wide enough to receive both piston-rings, which are in direct contact with each other. The reclaimed steam pistons cost less than one-third the cost of new ones.

These reclaimed pistons are considered superior to new ones for several reasons. The brass wearing surface causes less wear on the cylinder walls, and there is a thicker outer wall adjacent to the rings, which reduces the amount of breakage in comparison with a new piston having two separate ring grooves. Moreover, when two rings are placed together in the same groove, a tighter joint is obtained, since leakage through the ring joint or cuts is prevented. These reclaimed pistons have been used for three years, and have

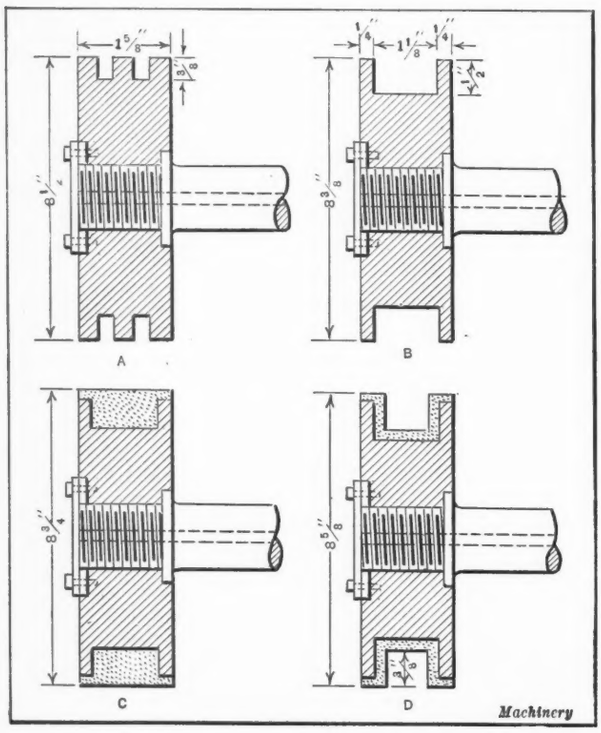


Fig. 20. Method of reclaiming Air Pump Pistons which are refitted to Cylinders enlarged by grinding

never given any trouble whatever. The cost of reclaiming a high-pressure steam piston for an 8 1/2-inch cross-compound pump is as follows:

Roughing out before welding, 1/4 hour at 75 cents per hour	$0.19
28 cubic feet of oxygen at $1.40 per 100 cubic feet	0.39
27 cubic feet of acetylene at $1 per 100 cubic feet	0.27
Labor cost in welding process, 1 hour at 80 cents per hour	0.80
Brass welding rods, 3 1/2 pounds at 45 cents per pound	1.61
Flux	0.10
Turning piston and polishing rod, 3 hours at 75 cents per hour	1.13
Total cost of reclaiming	$4.49

The cost of reclaiming a low-pressure steam piston can be approximated from the foregoing figures. The cost of a new piston (minus the rings) for an 8 1/2-inch cross-compound pump is $19.14. As the cost of reclaiming a similar piston is $4.49, as shown by the foregoing items, the amount saved by reclaiming is $14.65.

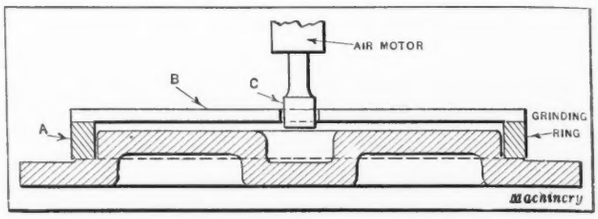


Fig. 21. Cylinder Joint Grinding Ring revolved by Air Motor

RING FOR CYLINDER HEAD GRINDING

By CHARLES E. LYLE, General Shop Foreman
Chicago, Rock Island & Pacific Railway

The cylinder joint grinding ring to be described makes it possible to grind cylinder head joints without removing the studs. The same ring can be used for grinding the joint either on the cylinder or on the head. The diagram Fig. 21 illustrates how this grinding ring is applied to a head. The grinding is done by ring *A*, which has a bar *B* extending across the center. This bar is engaged by fork *C*, connected with an air motor which revolves the ring. The ring should preferably be made of cast iron, although wrought iron of, say, 1-inch or 2-inch cross-section may be substituted. This ring should be bored out so that it will revolve freely when placed on the cylinder head. A suitable grinding compound, of course, is placed between the ring and the joint to be ground. Cross-piece *B* clears the cylinder head and is attached to the ring, either by screws or by electric welding.

This ring not only makes a perfect joint, but it also removes irregularity, such as is caused by warping of cylinder heads; consequently, it is not necessary to face the joints, as the grinding ring straightens them. When the ring is applied to the cylinder joint, pieces of pipe are placed on the cylinder head studs for the ring to roll on as it is revolved by the air motor. If the joints are ground by using this ring, the cylinder head may be assembled in any position. This method of grinding joints has been employed for two years with very satisfactory results.

RESEATING TOOL FOR INJECTOR FEED-PIPE

By F. H. WICKS, Tool-room Foreman
Norfolk and Western Railway Co.

The present method of connecting the feed-pipe to the injector is by means of a brass bushing brazed on the end

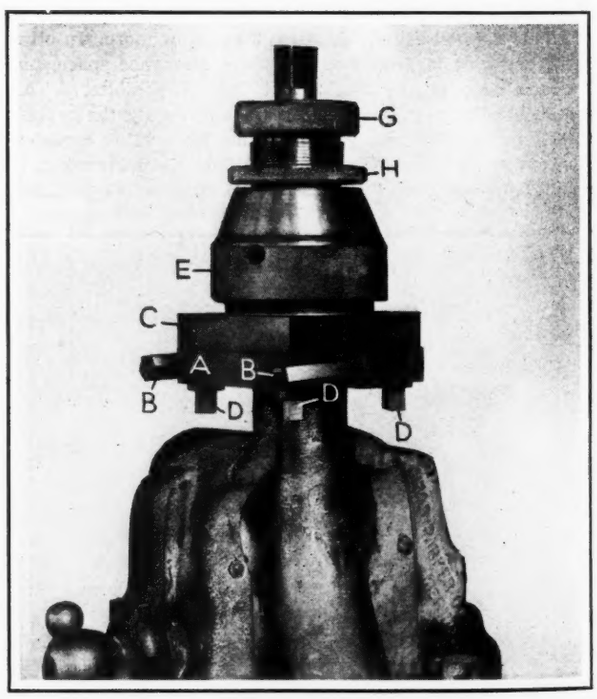


Fig. 22. Reseating Tool for truing Ball Joint on an Injector Feed-pipe

of a copper pipe. In brazing, the surface of the joint is destroyed, as the brazing material collects on the face of the joint and causes a rough surface. Owing to the length of the pipe and its bent shape, it is impracticable to machine the joint to produce a smooth surface.

The common practice has been to file the joint as smooth and even as possible, and apply a thin joint of "Goodyearite" packing, which for a short time makes a good joint between these connections; but due to this packing breaking or becoming soft by the action of water and steam, it does not last long. This leak admits air to the injector, which naturally affects the operation of the injector, causing it to "foul." Hence, it is often necessary to replace the packing between these joints.

With the reseating tool to be described, it is possible to make a perfect joint quickly and eliminate the use of packing. Fig. 22 shows the reseating tool assembled, ready for truing the ball-shaped joint on the feed-pipe, and Fig. 23 represents a sectional view of this tool. The split clamp *A* (see both illustrations) is first secured to the pipe below the joint by tightening screws at *B*. The base *C* is next secured to the clamp by four screws *D*. Then the body of

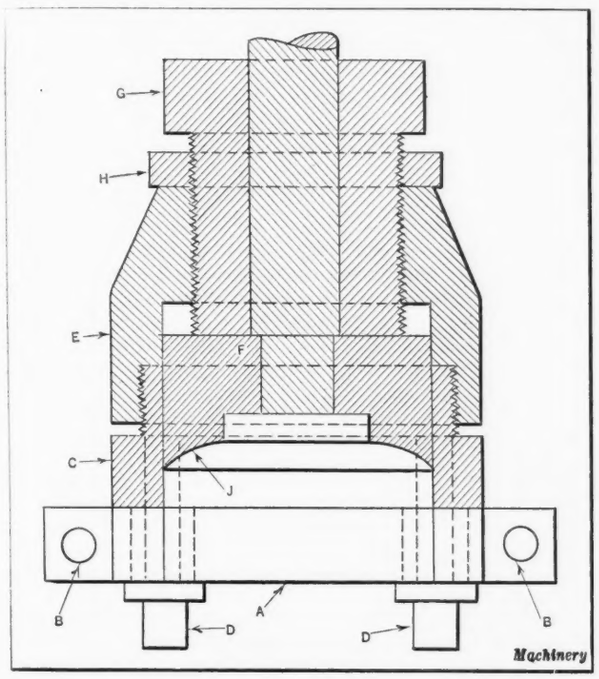


Fig. 23. Sectional View of Reseating Tool illustrated in Fig. 22

the tool *E* is screwed on the base *C*. This body contains the concave reamer *F* (Fig. 23), knurled adjusting nut *G*, and knurled jam nut *H*. The reamer is turned by a hand wrench, and the concave cutting edges at *J* quickly produce a true joint on the end of the pipe. The use of this tool will prevent many leaky joints between the feed-pipe and injector. Another reamer is provided for reconditioning the injector joint by removing any scale or roughness, so that this seat, as well as the one on the pipe, will be in good condition.

PRESS FOR PISTON-VALVE BUSHINGS

By J. H. DOWELL, Shop Foreman
Norfolk and Western Railway Co.

A portable hydraulic press is now being used at the Norfolk and Western Shops, Bluefield, W. Va., for pulling in main piston-valve bushings. The old method of applying these bushings consisted of using a long threaded rod equipped with end plates and a nut that was turned by using a hand-operated wrench. This method was slow and laborious, and two men (sometimes three) worked six to eight hours in pulling in a set of four bushings. The improved hydraulic method to be described saves labor and time, and reduces the idle period of a locomotive at least

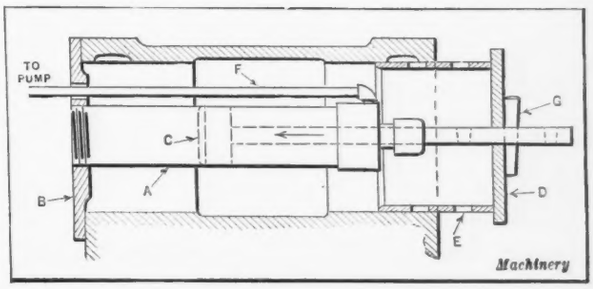


Fig. 24. Diagram illustrating Arrangement of Hydraulic Press for pulling Piston-valve Bushings into Cylinders

five hours. A machinist and helper can apply a set of four bushings in one hour with the hydraulic press.

The diagram Fig. 24 illustrates the principle of operation. Hydraulic pressure is supplied by an old-style boiler feed pump, having a cylinder 1 1/4 inches in diameter and a 2-inch stroke. A pump such as is used in shops for applying the hydrostatic test to boilers can be used instead. The diagram merely shows that part of the press which applies pressure to the bushing. Cylinder *A* is screwed into a plate *B* which covers one end of the valve chamber. Within the cylinder there is a plunger *C*, the rod of which passes through plate *D*. The latter engages bushing *E*, so that when pressure is applied from the pump through 1/2-inch pipe *F*, the bushing is forced into the valve chamber.

Cylinder *A* is made of 5-inch steel tubing, 24 inches long. Plunger *C* is provided with a leather packing cup, and is attached to a rod 1 1/2 inches in diameter and 30 inches long. This rod is provided with three keyways for receiving key *G*, which bears against plate *D*. These three keyways provide for variations in the lengths of bushings.

HOOK FOR LIFTING PISTONS

By S. G. BROADHURST, Locomotive Foreman
Canadian National Railways

In assembling a piston and rod into a cylinder, some means of lifting the piston must be provided that will not permit it to slip when it is entering the cylinder. If the piston-rod is without a front extension, it is necessary to attach the lifting device directly to the piston-head. As a rope or chain sling is likely to slip, the safety hook illustrated in Fig. 25 was designed for use in the Joliette Shops of the Canadian National Railways. The joint of the forward ring is spread far enough to admit the hook in the ring groove, as shown at *A*. The hole *B* is large enough to clear the piston-rod nut so that the hook is not held away from the front surface of the piston-head and is held in a central position. The same hook can also be used for lifting piston-rods having front extensions, as the extension simply passes through hole *B*. This device is not only safer to use than a rope or chain, but also more rapid and convenient.

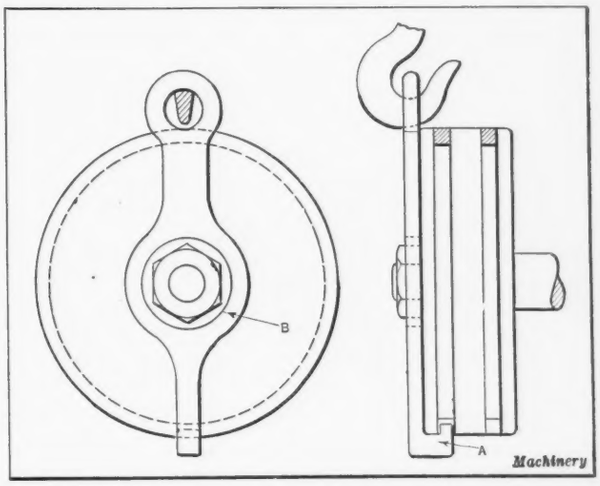


Fig. 25. Safety Hook for lifting Pistons into Cylinders

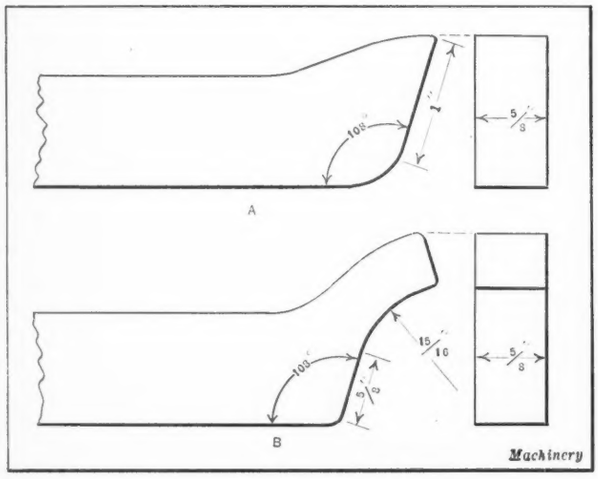


Fig. 26. Tools used in Pneumatic Hammer for hammering and forming Metal applied to Worn Tire Flanges by Oxy-acetylene Process

FILLING WORN LOCOMOTIVE TIRE FLANGES

By F. R. MILLIGAN, Foreman Boilermaker
Kettle Valley Railway Co.

Worn tire flanges may be built up to standard shape by the following method while the tires are in place and without turning them to obtain the right size or shape. The metal is first added to the tire by oxy-acetylene welding; then this metal, while still very hot, is hammered down to shape by using a pneumatic hammer equipped with special forming tools.

To prevent the added metal from cracking and falling off in pieces, that section of the tire to be welded is protected by partially enclosing it, using firebrick and sheet asbestos. The firebrick is laid on the frame to form a backing for, say, 2 or 3 feet along the inner face of the tire. Sheet asbestos at least 1/4 inch thick is then placed in the front to provide a front wall of 2 or 3 feet. A strip of asbestos wide enough to cover the flange and tread is then bent around the tire, leaving an opening on top to expose about 10 inches of flange and tread for welding. This enclosure keeps the tire to a more even temperature while welding and prevents contraction strains.

As the metal is added, it is hammered down by using formed tools. Tool *A* (Fig. 26) is used first to hammer the metal in at the heel of the flange, and then tool *B* is used to round off the top and finish the face. These tools were made of 7/8-inch hexagon steel, and the ends not shown were turned to fit the pneumatic hammer. About 4 to 5 inches of flange is filled in at a time, and while the metal is still white hot these tools are applied. Thus the hammering process is about the same as hammering two pieces of metal together in ordinary welding. The flange is finished smooth and to gage size, and no turning is required.

About 300 cubic feet of acetylene gas and 360 cubic feet of oxygen are required for a 56-inch tire. The time varies from 6 1/2 to 7 hours, depending upon the condition of the flange. The filler rods are made from scrap tire; they are drawn out under the steam hammer to 1/4 inch square, and are cut in lengths of about 4 feet. This welding and hammering process is applied to engine truck wheels, as well as to driving wheel tires.

FORGED RETURN BENDS FOR SUPERHEATER UNITS

By C. O. BUTLER, Shop Inspector
Atlantic Coast Line Railroad Co.

The officers of the mechanical department at the Waycross Shop of the Atlantic Coast Line Railroad Co. concluded that it would pay to manufacture return bends for replacements made on superheater units. After several months experimenting, a die has now been perfected that will form these return bends in three operations and two heats. So far as we know, this is the only shop making return bends in an upsetting type of forging machine. While the experimental stage has not been passed entirely, indications are that a saving of about 100 per cent will be made over the present purchaser price of suitable return bends.

Fig. 27 illustrates the sequence of operations, and Fig. 28 shows the die and the plungers, or headers, used in connection with a 4-inch Ajax forging machine. The view in the lower left-hand corner of Fig. 28 shows the recesses in that part of the die indicated at *K* in the plan view; the other half *L* is shown only in the plan view.

These bends are formed from blocks of soft steel, measuring 3 1/2 inches by 2 1/2 inches by 1 3/4 inches thick. The blocks are placed in an open-front oil furnace, and heated to a bright red. The forging machine is equipped with the plunger shown at *D* for the first operation. One of the steel blocks is removed from the furnace and placed on two 3/4-inch dowel-pins *E* that protrude just below the recess *C* in the die (see also sections *z-z*). After the die is closed, plunger *D* advances, causing the metal to flow and fill the die, as illustrated by the upper diagram, Fig. 27. The extension *F* that flows out of the back end of the die provides a convenient means of handling the forging. This completes the first operation.

Tongs are now used to hold the forging by extension *F*, and the die is opened. Then the forging, without additional heating, is placed in recess *B*, Fig. 28 (see also section *y-y*), and the die is closed. The plunger is not used for the second operation, but a U-shaped piece of steel *G* is placed in the open end of the forging to prevent collapsing. This piece is held in a recess cut in each half of the die. The die serves to close partly the sides of the forging at the center of the open end. There is an opening of about 1/4 inch left at *H* (see Fig. 27) preparatory to welding. Some of the excess metal left on each side by the first operation flows during the second operation, so that the stretching of the sides does not reduce the wall thickness. (The second operation has been performed under a Bradley hammer in a separate die

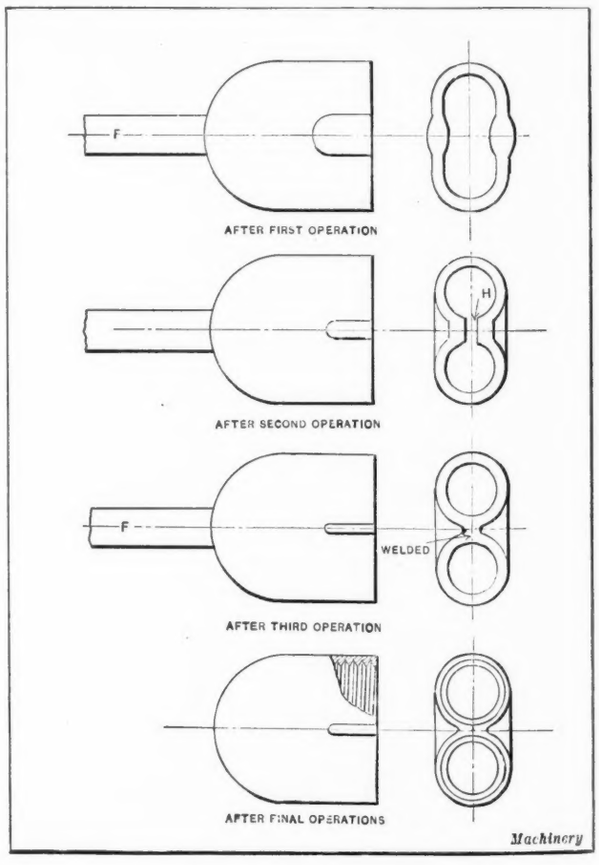


Fig. 27. Order of Operations in forging Superheater Return Bends on Upsetting Type of Forging Machine

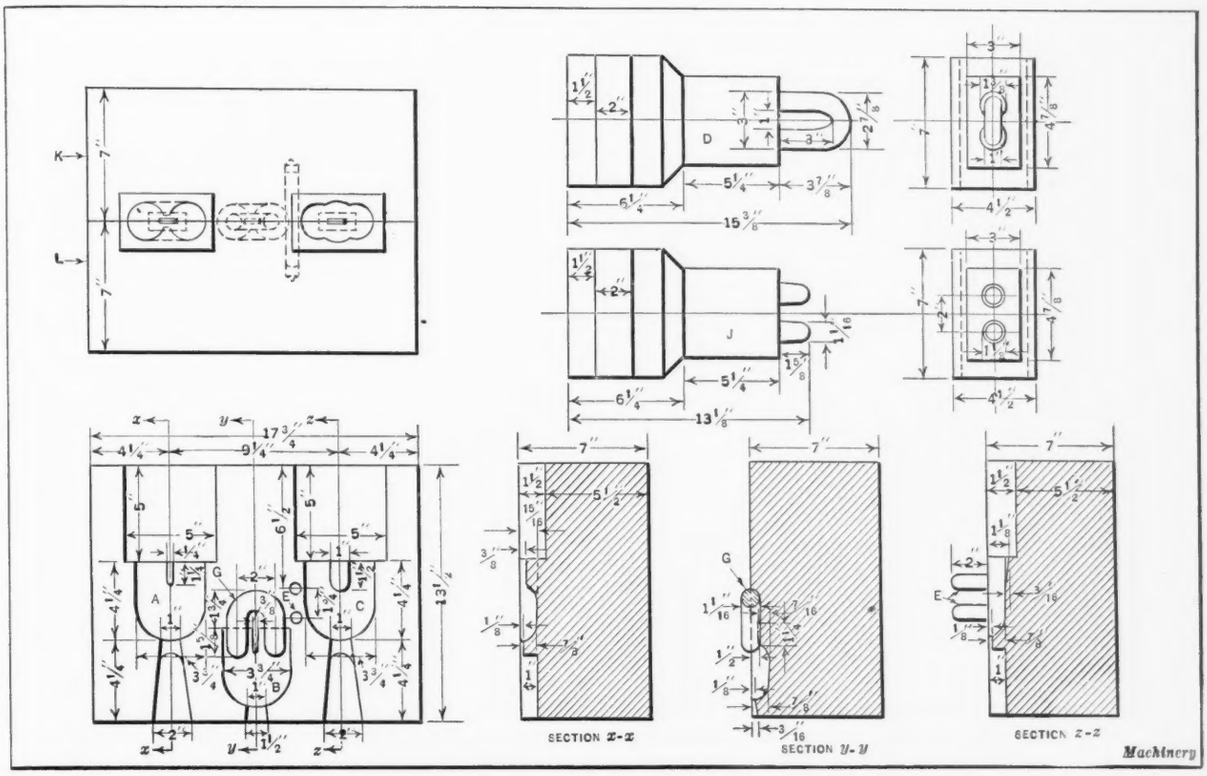


Fig. 28. Forging Die and Plungers, or Headers, used in forging Return Bends

similar to the one illustrated by section *y-y*, Fig. 28. The main die is now being altered to conform with the sketch.)

The third operation requires a welding heat at the open end of the forging, the place where the weld is made being indicated in Fig. 27. After the forging has been removed from the furnace, it is placed quickly in the recess *A* (see also section *x-x*) and the die is closed. The inner walls are forced together at the center, and header *J* advances, opening the two holes to the desired diameter and welding the sections between the two openings. The extension *F*, Fig. 27, is next cut off, the fins removed, and the openings reamed and tapped. A finished return bend ready for application to superheater units, is shown at the bottom of Fig. 27.

REAMER FOR STEAM PIPE JOINTS

By L. M. TUTHILL, Shop Foreman
Chicago, Burlington & Quincy Railroad Co.

Anyone who has attempted to grind a pitted steam pipe joint in order to make it tight will appreciate a reamer for truing the joint so that comparatively little grinding is required. The reamer illustrated in Fig. 29 is for flat joints, but the same general design may be used for the spherical or ball-shaped joints, by using cutters of corresponding form.

The reamer blades *A* are fixed in a holder *B* which has gear teeth around its circumference. This gear meshes with pinion *C*, which in turn, is revolved by an air motor, a No. 1 "Little Giant" motor being used. The ratio of this gearing is 6 to 1. The reamer is held in position by three plugs *D* located in holder *E*. This holder is 3/32 inch smaller than the inside diameter of the steam pipes, and it is inserted in the pipe so that plugs *D* can be forced outward in order to hold the reamer in position. This outward movement is obtained by tightening nut *F*, which draws inward the conical headed bolt shown. The cutters are fed against the face of the steam pipe joint by means of feed-nut *G*. This nut is turned with a spanner wrench, and it bears against the brass floating ring *H*, which, in turn, pushes the cutter-head forward.

This tool has been in use for six months in the Havelock shop of the Chicago, Burlington & Quincy Railroad Co., and it has given very satisfactory results. It was designed by Karl Merting, tool-room foreman. The tool is made of mild steel throughout, with the exception of plugs *D*, which are of tempered carbon tool steel, and cutters *A*, which are of high-speed steel. The average time required to place the machine in position, ream a joint, and remove the machine, is ten minutes.

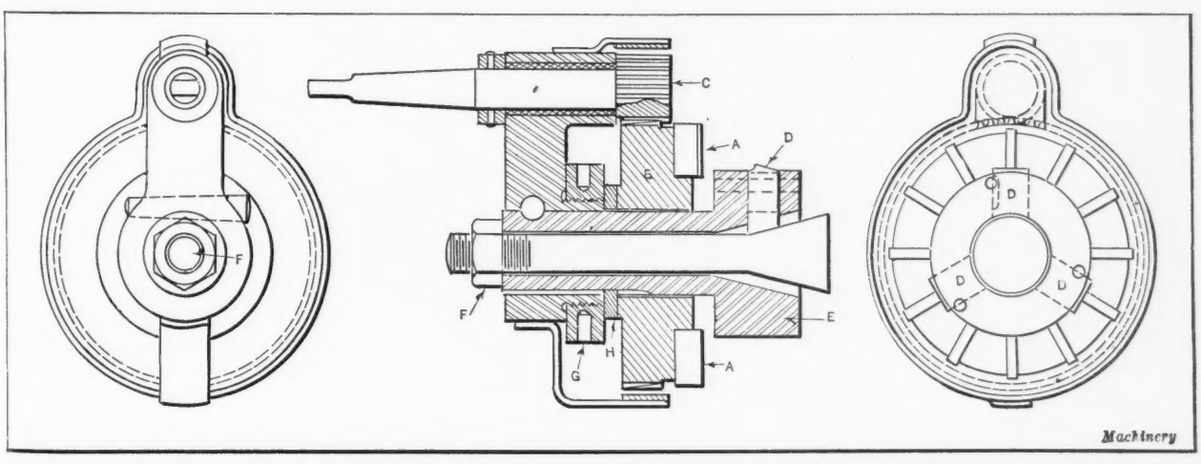


Fig. 29. End and Sectional Views of a Steam-pipe Joint Reamer which is rotated by a Standard Air Motor

Planning and Routing Shop Work

By J. SETON GRAY, Industrial Engineer, A. O. Smith Corporation, Milwaukee, Wis.

OF all the methods that in late years have been applied to industry to reduce the cost of production, planning occupies an important place. In all factories, there should be a planning department, regardless of the size of the plant. One man can take care of this work in small factories, while in a large shop, manufacturing a large line of products, a manager and staff of assistants will be required. It should, however, be kept in mind that where the work of the planning department stops, there the planning of the foreman must start; no foreman can hope to be successful unless he plans the work of his department.

General Duties of the Planning Department

The planning department determines what work is to be done; how this work will be done; what department, tools, and equipment will be used; and the time when the completed or semi-completed article must reach other departments. If there is any falling down in production or increase in production costs, this can generally be traced to lack of proper planning. The chief function of a planning department is to relieve the general superintendent and the factory foremen of routine work which might take them away from their departments, where their attention and presence is necessary at all times. It also permits complete production control, enabling the factory to produce more with an expenditure of less effort. To keep every man and every machine busy for the greatest possible length of time is also a function of the planning department.

The planning department must schedule the work of the whole factory in advance of the time when the work is to be performed. In some factories the planning is done ninety days ahead of time, but in very few places can the requirements be seen so far ahead. It should, however, be quite possible to plan a schedule at least a month ahead; the schedule can be revised later, within certain limits, if necessary. In any case, it is quite possible to forecast conditions at least a week in advance, which should give the production men sufficient time to get the product through the factory on time.

When the finished schedule for the factory has been determined, a schedule must be worked out from this for all the different departments, so that the work can be scheduled through these various departments; and the planning department must arrange the flow of work through the factory so that all parts will be taken care of in the various departments in ample time so that they will reach the assembly or shipping department when required.

Advantages Gained by Proper Planning

Planning, properly carried out, will cut down the quantity of materials in process, thus eliminating a great deal of factory congestion, as there will not be nearly so much material lying around. It also means a reduction in the amount of finished product carried in stock, as deliveries can be met by properly scheduling orders.

The closer the factory can work to the demands of the sales department, the less will be the carrying charges in the factory, and when the product represents a large investment in labor and material, this may make the difference between a profit and a loss. Planning will enable a general manager to control his business.

A steady flow of material to and from a department means that the workman can produce to his maximum limit. This is very important, not only to the management, but also to the men, in factories where the earnings of the men depend on the amount of work done. To achieve this steady flow, planning must be done by the production department to get the material in hand, and by the foremen to see that the work is started properly.

Effect of Planning on Cost and on Delivery Dates

From the data at hand in a planning department, it is possible to compile standard costs—that is, the lowest possible costs that can be obtained. This checked against the actual costs will enable the manager to determine the factory efficiency from a labor-cost standpoint. In order to determine efficiency, there must be a unit of comparison, and the best unit that can be used is the lowest possible cost that can be obtained by present means of manufacturing.

A planning department properly managed will reduce the quantity of material in process in the shop, relieve the congestion of half finished parts, and reduce the amount of finished product carried in stock. It will aid in accurately calculating costs and in maintaining production at predetermined costs. It will make it possible to set delivery dates with the assurance that promises can be kept, and it will enable the management to coordinate or synchronize the different manufacturing departments so that they will all do their share toward maintaining the predetermined production schedule.

Without a schedule, or proper planning, it is practically impossible to make promises regarding delivery of material. In the manufacturing of an accessory for use in the automobile industry, it was found that there were 520 separate operations necessary in forty different departments; in addition to these operations, seventy-seven crane handlings and sixty-nine truck handlings were required before the finished article was produced. As this article was handled in thousand lots, the magnitude of the job of synchronizing the operations in all departments, so that all parts would reach the final assembly at the proper time, can readily be appreciated. Many of these parts were quite bulky, so that lack of coordination on the part of one department threw the whole factory out of balance, because a great deal of floor space was taken up with material that had to be pushed aside until other departments were ready to handle it. It is impossible to handle the product of a factory of this kind without proper planning, not only by the planning department, but by every departmental foreman. As a general rule, the greater the variety of lines manufactured and the more operations necessary, the greater is the need for a planning department.

Men in Charge of Planning Need Broad Experience and Good Judgment

Laying out a schedule for machine operations, such as power presses on pressed steel work, is fairly easy, as the speed of the machine is known and the production, based on past performance, can readily be obtained. When, however, it is necessary to estimate time on hand work, the task becomes more difficult, and this is where a good planning engineer, with a great deal of experience, can show his real value. He must be able to prepare a work schedule that will fit in with the production from all departments, and to estimate closely the results of the efforts of workmen on hand work.

The planning engineer must prevent even the cheapest or smallest piece from being sidetracked. No matter how much of the work has been finished, if the whole is not com-

pleted and shipped, there are no returns to the company, as the customer pays for a finished product only. A delay in the work on a small insignificant piece may prevent the company from collecting thousands of dollars, which may be badly needed—all because a few cents worth of work was not performed at the proper time.

Whenever it is necessary to change a predetermined schedule, there will be a reduction in the factory output, if for no other reason than that the changing over of machines from one set-up to another requires time. For this reason, when a schedule is once determined, it should be maintained, unless there are very important reasons for the change. Every change in schedule should be investigated, because these changes always increase manufacturing costs.

Before deciding that present methods are wrong and should be changed, be sure to study them thoroughly before adopting anything new. Generally speaking, it is advisable to undertake improvements gradually rather than to change an entire system arbitrarily. This is especially true in regard to routing material through the shop. It is best to make the change gradually, rather than to make a complete change over night. In this way it is possible to be on the safe side by making sure that the new method will work to satisfaction, before the old method has been entirely discarded.

Some Details of the Work of the Planning Department

The men making up the personnel of the planning department must know the characteristics of all the machinery in the factory and know the various operations that can and should be performed in the different departments. They must keep in touch with the purchasing department and see that the raw material is received at the proper time. Drawings must be furnished to the tool-room and tools prepared ready to perform the work; drawings must also be furnished to every departmental foreman in time so that he knows what to expect and can prepare his plans for handling the work. Whenever it is possible, the planning department should determine the number of man-hours and machine-hours necessary to perform the work scheduled, and see that both are available. From this information, it is possible to determine whether over-time is necessary in order to secure sufficient running time on certain tools and equipment.

When production has been properly planned beforehand, it is possible to maintain a steady flow of material or semi-finished products to every department, so that each department and each workman can produce the maximum amount. This is very important, not only to the management, but also to the men, in factories where the earnings of the men depend upon the amount of work done. To achieve this steady flow of material, there must be thorough cooperation between the planning department, the production department, and the foremen.

The foreman has a right to expect that the planning department will not only demand that he finish his product by a certain time, but that it will see that he is furnished with ways and means that will enable him to do so. When there is no organized plan, this work must be performed by the foreman himself, and as his work depends on the work of some other department, a great deal of his time is actually spent in the capacity of stock chaser. When this work is done by the superintendent and the foremen, it is everybody's job, which generally means nobody's job. On the other hand, when one central department is responsible for the production of all departments, the personnel of the central planning department is in the position to demand that certain foremen take drastic action, when necessary, so that all departments may be kept operating in a smooth efficient manner.

The Work of the Stock Chasers

In almost all factories, the production manager is really the head of the planning department. His assistants are scattered all through the factory to check up and see that no department is falling behind their schedule. These assistants, generally called "stock chasers," are responsible for the routing or dispatching of material through the factory. They must see that material leaves one department in sufficient quantities and in time to keep other departments busy, and they must not allow the production in any department to be interrupted, due to material which has been completed in some other department not being moved at the proper time. The stock chasers are responsible for the maintaining of clear aisleways, and they must make sure that no material is sidetracked in out-of-the-way places.

Unless the stock chasers are careful, there will always be trouble with the containers necessary to handle the product in the factory. These containers become sidetracked or lost, and others are made to take their places. Sometimes when certain orders are cancelled, the product, instead of being turned back to stock, is left in the factory, taking up space and utilizing container equipment. In one factory where they had eighteen hundred containers, it was decided that five hundred more were necessary in order to meet the requirements. Inside of ten days, with twenty-three hundred containers in use, there was again a shortage. It is not the amount of equipment on hand to move material that counts, but the intelligent use of it.

Cooperation between Shop and Planning Department

There should be an understanding in all departments that when men run out of work, or expensive machines are idle, the planning department should be immediately notified. Work must be scheduled so that all equipment is kept busy at all times. Expensive equipment costs money, whether running or idle, and all foremen should be instructed regarding the importance of notifying the planning department of idle equipment. It might be possible for the planning department to persuade the sales department to accept at a lower figure work that will keep the equipment busy, and in this way at least pay some part of the overhead, and not saddle all of it on the product that is regularly produced.

Progress of work must be reported by all departmental foremen to the planning department, if a schedule is to be maintained. This is the only way that the requirements of the sales department can be met and over-time avoided. These reports will vary according to the product of the factory, but they should be in a form that will enable the planning department to determine whether the work is coming through as it should. This is especially important in construction work, where certain sections of the project must be completed before other parts can be begun; also the quantity of raw material required for such work is generally large, and if the schedule is not maintained, the work is likely to be delayed because of the lack of facilities to store the material.

Factory Transportation must be Supervised by the Planning Department

Factory transportation, which includes the handling of material by trucks and cranes, is really a function of the planning department, and in many factories the transportation department obtains its instructions from the head of the planning department. Here is a fertile field for an able man, because the factory transportation system is really a miniature railroad system. In the hands of a capable man, who has his work scheduled so that he knows at what time of day trucking service will be required in certain departments, the problem becomes very simple. In many factories, however, it is believed that it requires no intelligence to run a truck, and that you can get all the men you want for that kind of work at forty cents per hour. You actually get what you pay for. In a case of a trucking job, low wages generally mean a great deal of lost time, the truck man moving ineffectually through the plant. It is generally a good plan, where trucks are employed, in order to check up on trucking department service, to step on a truck and ride around

for an hour or so, to find out how much of the time the trucks are actually doing constructive hauling. At the same time, the total cost of trucking service, including supplies, repairs, gas, oil, and labor, should be tied up with some unit representing the total factory production, so that some check can be made on the actual cost of the service. Often, there are a great many trucks running idle. Loads must be pulled both ways, and when material is delivered to one department, another load should be carried away from that department.

In order to overcome congestion arising from a poorly organized traffic department, many manufacturers operate conveyors. The speed of the conveyor often determines the production of a "line" in the factory. In this way, there is no congestion, and as a new piece is started at the beginning of the line, a finished piece comes off the end of the line. Such conveying equipment is costly, and it depends on the nature of the product whether the investment is warranted.

How Poor Trucking Service and Lack of Planning Interferes with Production

As an illustration of how poor transportation of material can upset a factory, the following experience is related. In one factory the transportation department took instructions from any of the foremen. This factory was equipped with an auto-call system. The trucking foreman had the call "three-two's"; that particular call was on the auto-call all day long. On checking up, it was found that the trucking foreman averaged about 140 calls per day, and that four or five hours of his time were spent in answering telephone requests for immediate service. How was it possible for a transportation department to furnish efficient service when every request was a rush order? A note was issued to every foreman suggesting that requests for service of this kind actually meant that they did not plan their needs for transportation and that it was felt that they could give more time to the trucking foreman, instead of demanding immediate service. The result of this communication was that requests for immediate service reached a low limit of four per day, and remained below ten per day for weeks afterward. If the foremen plan their needs for trucking service, the traffic department foreman has a chance to plan his own work; he is then in a position to furnish the proper service to all departments.

The planning department must schedule the work of the whole factory some time in advance of the time when the work is to be done. In some factories, the planning is done ninety days ahead of performance, but in very few places can the requirements be determined that far ahead. In most cases, it is possible to plan the schedule a month ahead. Sometimes it may be necessary to plan only a week in advance; a week generally gives the production department sufficient notice to get ready for the work to be handled.

A similar condition was found in regard to crane service. In the main aisle of the factory all machines were served by three overhead traveling cranes. Quite often you would see one crane driving the other two ahead of it. The two would have no load and the other one had to deliver its load to the far end of the shop. Investigation showed that the amount of waiting time for crane service was appalling, and the difficulty was overcome by fixing the territory to be served by each crane. When a crane had to encroach on the territory served by another crane, the load was landed, and the other crane picked it up when opportunity presented itself. At first it was thought that more cranes were needed, but investigation showed that using what was already on hand in an intelligent manner produced the desired results.

Conclusion

Planning is the foundation of all business. It makes no difference whether the business consists in running a large construction job or a small shop, a large factory or a corner grocery store; in order to be successful, the work must be planned step by step. If the work is planned, one knows beforehand what the possibilities are of breaking even or making a profit, and consequently one knows what to watch out for. To be successful, one must cultivate the faculty of planning, and this applies to the workmen in the factory as well as to the foremen, factory managers, and owners.

HIGHER PRESSURES FOR STEAM POWER UNITS

New steam power installations referred to in a recent issue of *Mechanical Engineering* show clearly the tendency toward the use of higher pressures for operating steam engines. To obtain increased thermal efficiencies, steam pressures have been increased successively from 200 to 300 pounds, then to 350 pounds, and next to 400 pounds per square inch. The latter pressure appears to be the limit for boilers of present-day standard design. Above this point, the advantages of increased pressure decrease rapidly unless combined with the reheating of the steam at some point during its expansion. This introduces many complications which tend to prevent its use in any but the very large plants.

At least three stations employing the reheating principle, and operated at pressures of about 600 pounds per square inch, are now in use, and several more are in the course of construction. An installation in the Edgar station of the Edison Electric Illuminating Co. of Boston and Weymouth, Mass., utilizes two pressures, the main portion operating at 375 pounds. In addition to this, there is a boiler and a turbine operating at a pressure of 1200 pounds per square inch. The turbine exhausts at 375 pounds pressure per square inch through a reheater (located in the setting of the high-pressure boiler) into the steam system of the main portion of the plant.

The use of such high pressures has necessitated redesigning piping valves and fittings, which up to the present time have been designed for pressures of only 250 pounds per square inch. The work of developing suitable pipe and fitting standards for steam pressures up to 1500 pounds per square inch, however, has been practically completed, and attention is being given to the production of materials for this equipment that will be suitable for temperatures above 700 or 725 degrees F., which is about the practical limit for present available materials.

Pressures of 250 pounds, and in one case 350 pounds per square inch, have recently been employed on locomotives. It is stated that a high-pressure steam plant for installation in steamships is now being built at the works of William Denny & Bros., Dumbarton, Scotland. The steam for the turbines will be supplied by two water-tube boilers working at a pressure of from 500 to 550 pounds per square inch, at a temperature of from 700 to 750 degrees F. The steam pressure used in this installation would therefore be about double that of any existing marine equipment.

* * *

A. S. M. E. MEETING IN SAN FRANCISCO

The regular spring meeting of the American Society of Mechanical Engineers this year will be held in San Francisco, Cal., June 28 to July 1. There will be five technical sessions dealing, respectively, with industrial training and education, fuels and railroads, hydraulic engineering, oil and gas power, and petroleum. A paper on "The Growth of University Extension Training of the Non-college Type for the Industries of the West" will be read by John L. Kerchen. Another paper on "Education and Training of Apprentices on the Pacific Coast," will be read by Paul Eliel. Other subjects of general engineering interest will relate to speed changes of hydraulic turbines for sudden changes of load, oil engine locomotives, oil engines for pipe line pumps, fuel oil for railways, and "caterpillar" tractors. A special train that will leave New York for San Francisco and that will be parked there for the return journey, will make it possible for eastern members of the society to attend the meeting conveniently and make the trip without change of trains.

Supply and Machinery Distributors' Meeting

THE important papers read before the twenty-first annual convention of the National Supply and Machinery Distributors' Association held in Atlantic City late in April, were briefly referred to on page 743 of May MACHINERY. In addition to the papers, there were general discussions covering a number of subjects, among which may be mentioned: "How Can the Manufacturer Assist the Distributor to Secure Increased Turnover?" "Which is More Desirable, Missionary Salesmen or National Agents?" "It is Now Generally Accepted that Overhead Expenses Cannot be Naturally Reduced; How, Therefore, Can the Distributor Secure an Adequate Net Profit?" "What Gross Margin Should the Distributor Secure on Staples? On Specialties?" "The Service Rendered by the Association in the Collection of Delinquent Accounts"; "Should the Agitation for a Change in Our Present System of Weights and Measures be Regarded Seriously?" "How Can We Compensate House Employes so as to Secure Loyal Service and Cooperation?" and "How Can a Manufacturer Secure Distribution in a Territory Where There is Only One Distributor, Who is Handling a Competitive Line?"

Commendation of Work of Simplified Practice Division

B. H. Ackles, of the T. B. Rayl Co., president of the association, in his annual address referred to a number of important activities of the association. He mentioned that the recently established associate membership, whereby those manufacturers interested in disposing of their products through distributors rather than by direct methods of selling, could become members of the association, is the foundation of a structure that should be of great value to the industry.

B. H. Ackles, Re-elected President of the National Supply and Machinery Distributors' Association

Particular attention was paid to the work of the Division of Simplified Practice of the Department of Commerce. A number of lines of goods directly affecting the mill supply field have been simplified. Many manufacturers have worked with the Department of Commerce in an endeavor to eliminate unnecessary sizes or types of products. In some instances, unfortunately, manufacturers had met and worked with the planning committee up to the point of adopting a simplification plan, and then at the last minute had decided against simplification, indicating that they each wished to operate their own business without cooperating with other manufacturers. This course is against the best interest of the distributors and users of manufactured products, and is contrary to the cooperative spirit that generally characterizes the modern business man of today.

The Distributor's Place in the Business Structure

The report of George A. Fernley, secretary-treasurer of the association, covered practically every point of the association's activities. He emphasized the fact that the prosperity of the distributor and the manufacturer is so closely interwoven that one cannot suffer without the other being adversely affected. It is therefore evident that the interests of the manufacturers and the distributors of the products of industry are interdependent and that such problems as overproduction and hand-to-mouth buying are as important to one as to the other.

In referring to the distributor as a middleman, he pointed to the report that the Committee on Methods of Distribution of the National Distribution Conference, called by the Department of Commerce, had prepared after months of exhaustive examination and inquiry into the whole question of distribution. He quoted from this report the following statement: "The middleman, who is often blamed for taking too large a portion of the consumer's dollar, is performing a necessary function, which is performed by some other agency even if he is eliminated, so that the expense remains."

The Cost of Hand-to-Mouth Buying

Another important subject referred to by Mr. Fernley was the hand-to-mouth buying, or, as it has recently been termed, "piecemeal buying," which has increased the expense of doing business, particularly as orders for small lots and for parcel post shipments call for an unusual and additional amount of labor, packing, and accounting. Some distributors have endeavored to overcome this expense, to a degree, by carrying their own parcel post insurance, while still others have added to invoices an item called "guaranteed delivery," and lumped in this the postage and insurance, plus a service charge based upon a sliding scale, depending upon the value of the shipment. Information received indicates that this method of handling parcel post shipments by adding a charge for "guaranteed delivery" is being used quite extensively by distributors in other lines as well. Another interesting point brought out was that the cost of doing business in the mill supply field averages 20.77 per cent of the turnover.

On the subject of simplification, Mr. Fernley emphasized the statements previously made by Mr. Ackles, mentioning that the members of the association can greatly assist this work by drawing to the attention of manufacturers whose lines include unnecessary sizes, styles, and varieties, the fact that both manufacture and distribution can be cheapened and the interests of the consumer served, by eliminating unnecessary varieties. In this connection, he mentioned that, in certain lines, simplification has been blocked by one manufacturer refusing to cooperate. In such cases, the distributors might be able to influence the manufacturer who, for one reason or another, is unwilling to cooperate with other makers of the same product.

In connection with the convention, an exhibit was arranged of the products of a number of the associate manufacturer members. About thirty manufacturers availed themselves of this opportunity of showing their products, and some very interesting tools, supplies, and accessory equipment were on exhibition.

* * *

PREVENTING WARPING WITH HARDENING FIXTURES

In the case of pieces likely to warp in hardening, a hardening fixture that will hold the piece to be hardened straight while it is quenched will save a great many scrapped parts. Automobile ring gears may be mentioned as an example of parts for which hardening fixtures are valuable. It is important to use some material for the hardening fixture itself that will not warp readily when subjected to high temperatures. In some plants "Nichrome" is used for this purpose, and has been found to give satisfactory results.

Current Editorial Comment

in the Machine-building and Kindred Industries

FINANCING RAILROAD MACHINE TOOL PURCHASES

A questionnaire answered by about one-half the railroads in the United States is the basis for a recent estimate that their purchases of machine tools and shop equipment amount to from $15,000,000 to $20,000,000 annually, the western roads generally buying somewhat more freely than those in the east. These figures are larger than have usually been admitted by those who criticize the railroads for not buying equipment more freely for their repair shops.

But few critics of the railroads realize the difficulties under which they labor, due to government restrictions, or understand how they are required to finance their purchases. When a new machine tool is bought, it cannot be paid for out of operating income nor charged to operating expense. New capital must be provided and the purchase charged to capital account. If an old machine is replaced by a new one, the second-hand value of the old machine may be deducted from the purchase price of the new, but the difference must be charged to capital account; so that whenever a railroad buys new machine tools, it must pay for them from some other source than income from operation—that is, from the proceeds of the sale of additional stock or bonds. This seems to be an unreasonable requirement, because shop equipment is a prime necessity for efficient operation; and under these conditions, purchases are limited to the most urgent necessities.

There is a growing realization with railroad managers of the importance of maintaining the rolling stock in good condition. The mechanical executives are given more opportunity to decide upon the kind and quality of equipment to be purchased, and in spite of what has been said about antiquated equipment, many railroad shops compare favorably with others in the machinery jobbing field. It is manifestly unfair to compare the equipment of the railroad repair shop with a big automotive plant. If the mechanical executives of our railroads were allowed the money and the authority exercised by those of the average automotive plant, some highly profitable results would soon appear.

* * *

INCREASING OUTPUT, IMPROVING QUALITY AND REDUCING COSTS

To mechanical men it is unnecessary to emphasize the fact that increased accuracy generally accompanies the reduced cost of producing by machinery, or other mechanical means, work that was formerly done mainly by hand labor; nor to point out to men engaged in machine shop production that automatic and semi-automatic machinery will produce not only more rapidly, but also more accurately and uniformly than is possible by methods in which the skill of the operator is depended upon largely. Briefly, there is nothing new in the idea that improved mechanical means not only reduce costs, but produce a better quality of work.

But it is not so generally recognized that when production is increased, new possibilities are opened up for improving quality. On the contrary, the belief prevails that with increased production and the use of methods suitable for quantity output, accuracy is sacrificed. That is not necessarily the case. If production is large enough, there is nothing incongruous in an improvement of quality with a reduction of costs. There are many production methods that make possible superior quality, which cannot be adopted when the output is small, because the expense would be prohibitive, but with an increase in production these improved methods may prove economical.

An illuminating example of this is found in the use of diamond tools for boring the bronze bushings in connecting-rods and crankcases for automobiles. When only a few cars per day are built, the cost of the diamonds is prohibitive, although the finish produced on the bearing surfaces is generally superior; but when a hundred or more cars a day are built, diamond tools can be used, with the result that the quality of the product is improved, and the cost actually reduced.

* * *

MEN SUBMERGED IN SYSTEMS

As the industries have developed into constantly larger units, it has become necessary to devise adequate systems for the operation and control of these large plants; but in many cases, these systems have been carried to such an extent that the system has become everything and the men operating under it are mere cogs in a wheel. There is a tendency to depend too much on the system and too little on the judgment and ability of the men. A young clerk and the system under which he operates sometimes takes precedence over judgment based on many years of experience.

Instead of making foremen directly responsible for the results of the working of their departments, frequently they are so tied down by rules, regulations and systems, that they are unable to use their own judgment, and frequently must do things against their better judgment, because it is in accordance with the system. Undoubtedly systems are needed in the large plants of today; but when they run the shop, including the executives, an investigation is in order.

In the old-time shops sometimes there was too much individuality; in the modern shop often there is too little. The old New England shops prospered and excelled, because they gave full play to the Yankee ingenuity of the day. At the present time, in many plants only a small percentage of the ability and ingenuity available in the organization is utilized.

* * *

FILE 'MACHINERY'S' ARTICLES

The chief tool engineer of a large automobile plant makes a practice of looking over carefully every technical journal pertaining to his work and marking all articles of possible future value to his department. An assistant files these articles for quick reference. Whenever it is necessary to change the design of some work-holding fixture or to devise a new method for machining a part, reference is made to this file, so as to utilize the experience of other engineers on similar work.

A thousand pages of valuable material are published every year in MACHINERY, and every October a carefully compiled index to each volume is sent free to those who desire to preserve their copies. As a rule, it is not practicable for the average reader permanently to keep and file all of this material; but there are many articles applying so directly to the work in which he is engaged that it is a serious loss for him not to have a system for preserving such articles so that they can be found quickly when needed. The tool engineer mentioned uses for this purpose inexpensive manila folders in which articles on the same subject are filed together, and then placed in ordinary letter files. This simple system has been found to pay well for the small amount of time required to maintain it.

National Machine Tool Builders' Meeting

THE spring meeting of the National Machine Tool Builders' Association, held in Providence, R. I., May 6 and 7, was attended by an unusually large number of machine tool manufacturers. At the opening session, the president of the association, H. M. Lucas, president of the Lucas Machine Tool Co., Cleveland, Ohio, briefly reviewed the great change that has taken place during recent years in the public's attitude toward business and business men, pointing out that this attitude has changed because business has largely developed from the individualistic to the cooperative stage. "Business men," Mr. Lucas said, "find it good business to think in terms wider than their own shop walls; to think in terms of their community, their state, their industry, their nation. Each year this helps to make our country a better place to live in and a better place to do business in.

"Our industry lives by transferring skill and intelligence from men to machines. In doing so, it contributes enormously to human progress. Without a prosperous, healthy industry making the 'Master Tools of Industry,' the material progress of society would be retarded; but without a good organization to speak for the industry, it will not be healthy and prosperous.

"We all know that as business men we must pay for all our own mistakes, as well as for those of all our subordinates and employes. But the broad-visioned business man realizes that he often has to pay a very heavy price for the mistakes of his competitors, besides paying for those of his own organization. Through association cooperation, it is possible to prevent mistakes that would seriously injure a whole industry and every participant therein. Hence, the cooperative-minded see that it is good business for them to cooperate with others to this end, and to contribute such information as will prevent mistakes.

The Early Trading Methods must be Replaced

"I have often thought that some of the difficulties of establishing ethical practices in business may be due to the old trading customs that had their origin in the earliest days when business consisted only of shrewd bartering. The trader had no personal pride in the wares he sold, as his sole interest lay in his ability to dispose of them. All that mattered to him was the margin of profit he might obtain. That margin, expediency demanded, must be adjusted according to the circumstances surrounding each sale. Those circumstances nearly always threw their weight on the side of a quick turn of the trade, against the chance of total loss through no trade at all. With the development of the modern industrial system, the tactics of the trader carried over in the disposition of goods. In the early days of barter, "circumstances" meant the movements of the caravan, or the passage of ships, and the danger of being left behind, if one held out too long on a trade. In the early days of factory production, "circumstances" meant the stream of new goods coming constantly on the market.

"Within the memory of most of us, the development of advertising brought with it the craftsman's pride in a painstakingly planned and built product, sold to the user on the manufacturer's reputation and name. I like to think that it is the pride of craftsmanship that is helping to pull us away from the lesser ideals of those earlier times. The manufacturer's reputation for good work must have with it a reputation for fair dealing, under the present system of business. The spirit of the old-time trader, who was here today and there tomorrow, has had to give way to the necessity of more permanent methods of distribution. So the modern system cannot tolerate the methods of the past."

Proceeding, Mr. Lucas called attention to the nation-wide movements aiming at improving business ethics. "Business as we know it," he said, "would simply collapse if many men tried to do the unethical thing to any considerable extent. Hence, when industry draws up a written code, it merely puts on paper sound principles that business has always believed in and found necessary in practice. No code is written for the large majority; they have been doing the ethical thing right along as a matter of course. A code is written to point out rocks on which various business craft have been wrecked in the past. It concentrates in small space the experience of generations of business men. It would be a strange world and a poor one to live in if good ethics were bad business, and if bad ethics were good business. That illogical contradiction is just what the unethical man seems to think, but the experience of all humanity is that the ethical thing is likewise the profitable thing in the long run."

Activities of the Association

Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association, referred to a number of the association's activities during the past year. He spoke particularly of the importance of the statistical work carried on by the association, and in that connection, quoted a statement by Secretary Hoover in the introduction to the Department of Commerce's book on "Trade Association Activities," as follows:

"There is no question but that the curves of the business cycle from activity to depression have been less disastrous in those industries or trades where accurate, lawful statistical data have been available to all. Fundamentally, it is impossible for business men to form those vital judgments as to their future course of action in the wise and safe direction of their activities, unless they are informed as to the changing currents of production and consumption, not only in their own lines, but also in other lines of business; and if industry is to march with reasonable profits, instead of undergoing fits of famine and feast, if employment is to be held constant, and not subjected to vast waves of hardship, there must be adequate statistical service. Whether these services are to be maintained by the government or by trade associations, they must be maintained if we are to have an orderly economic life."

Value of Accurate Statistical Information

In further commenting upon this subject, Mr. DuBrul said: "Between industries, as between individuals, exchange of information makes for more profitable operation. Each year more and more industries begin to gather, report, and compare facts. This widespread movement is helping our industry right now. Leading executives of large buyers of machine tools are putting their brains to work on the problems of business stabilization. They are engaging qualified men to study buying, selling, and production policies, with that end in view.

"As more and more of the large users of machine tools adopt this policy, we shall see more orders for machine tools placed just when we want them most, and of course, less orders placed just when we need them least. That means a more stabilized market for tools; more stabilized employment and production; more stable costs; and more stable profits. Of course, improvement in these respects is bound to be slow. We shall never see the time when all machine tool buyers will have consulting economists at their elbows, nor when economists can forecast conditions with absolute certainty. So we can never expect to smooth out all the fluctuations in demand. They are too much a part of the very nature of machine tool demand, to hope for their elimination. We can only hope for and work toward a gradual decrease in their

violence, and while doing that, we must learn to run with the tide that we cannot control."

Another subject referred to by Mr. DuBrul was the prometric agitation. The work of the association in combating compulsory legislation to introduce the metric system was referred to.

Papers Presented before the Association

A number of addresses of unusual interest were presented before the meeting. James E. Gleason, president of the Gleason Works, Rochester, N. Y., read a paper on "Internal Standards—Their Necessity and Advantage," in which he called attention to what can be done within a manufacturing organization with a view to standardizing the product, indicating as well how much of this standardization can be of general benefit to the entire industry. C. W. Bettcher, secretary of the Eastern Machine Screw Corporation, New Haven, Conn., read a paper on "Simplification of Chaser Sizes—its Accomplishment and the Advantages to the User." A few of the statements in Mr. Bettcher's paper will be briefly referred to in a following paragraph. Roy V. Wright, managing editor of the *Railway Age* and editor of the *Railway Mechanical Engineer*, spoke on the subject "Selling Machine Tools to the Railroads." In the course of his remarks, Mr. Wright gave a very clear conception of the limitations surrounding railroad machine tool purchases, due to the fact that these cannot be financed out of operating income and charged to operating expense, but must be financed out of new capital and charged to capital account.

An address that caused a great deal of discussion was presented by W. L. Churchill, industrial engineer of White Plains, N. Y., on the subject "Insuring Profits by Intelligent Pricing." He emphasized the point that most of the financial losses in industry are due to the fact that costs are not known, and that even when they are known, prices are not intelligently based upon costs.

W. H. Rastall, chief of the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce, Washington, D. C., gave a brief address on "Present Condition of Foreign Trade." Other subjects discussed by the convention were the reconditioning and resale of a manufacturer's own machines, deferred payments for machine tools, normal burden and cost of idleness, and the servicing of machine tools. The advertising committee, of which F. B. Heitkamp of the Cincinnati Milling Machine Co., Cincinnati, Ohio, is chairman, presented a report which covered many of the phases of the association's advertising and of the advertising by individual members.

Standardization of Die Chasers

In his address on the standardization of thread sizes cut with self-opening die-heads, Mr. Bettcher pointed out that a check-up among the different die-head manufacturers showed that each manufacturer was carrying in excess of 1500 different chaser sizes in stock, and that only about 200 of these sizes showed a turnover more frequently than once a year, at least half of the remaining only showing a turnover of once in two or three years. These figures concern chasers by sizes only. Taking the demand for sizes by volume of chasers ordered, over 80 per cent of the demand by volume is covered by less than 200 sizes, and the remaining 1300 sizes are ordered in very small quantity.

Proceeding, Mr. Bettcher said: "Now consider the manufacturing problem involved where chasers must be made to fill special orders. First, special tools are required for threading the chasers. Then special blanks must be made having the proper length for the root diameter of the screw to be cut. Machines that are set up for these special chasers require special supervision and calculations. Therefore considerable time is expended in the necessary preparations, whereas the actual production time may be small. Naturally, the cost of making special chasers in small lots is all out of proportion to the cost of making chasers that are in steady demand. In fact, the costs for special chasers often run much higher than could reasonably be charged to the customer.

In the manufacture of chasers, there is considerable uncertainty as to whether the number of chasers started will pass all inspections and be accepted when finished. So in small-lot production, a loss of one set of chasers represents a large percentage of the order. In the case of chasers of popular sizes run in large lots the loss of one set is not serious. A large number of small special orders have a disorganizing effect on production. They necessitate the continual breaking into regular production, and the labor of specially skilled operators who, by nature, are particularly adapted to undertaking this special work. It is therefore difficult to make promises on the delivery of special chasers."

Value of Standard Die Chasers to the User

From the standpoint of the user of self-opening die-heads, adoption of standard thread sizes provides him with the following advantages:

1. Much more prompt delivery of chasers, since chasers for standard thread sizes are either usually in stock or already in process.
2. Saving of the extra charges that should be made for special chasers.
3. Better quality chasers, since those that are made in large numbers almost daily can be held to closer tolerances and greater uniformity than those made up specially to order.
4. Reduction of chaser stock, since a smaller number of thread sizes will be used.
5. Better fit between screws and tapped holes, as taps will also be bought in standard sizes.
6. Saving of the extra charges that are made for special taps.
7. Ability to use standard gages that are stocked by the gage manufacturer for standard screw thread sizes.
8. Strong talking point for product, because it is assembled with standard threads instead of with mongrels.

It is a decided advantage to the user of any piece of mechanical apparatus, to find that all threaded parts used in its assembly have standardized threads. Usually the equipment is used at some distance from the manufacturer, and in case repairs are necessary, it is decidedly inconvenient to find that the threaded parts are of mongrel sizes and cannot be reproduced or rethreaded near at hand. Very serious delays and even accidents, in some cases, are often traced to such causes.

* * *

MACHINERY EXPORTS TO ARGENTINA

According to information furnished by the Industrial Machinery Division of the Department of Foreign and Domestic Commerce, the United States exported, during 1925, industrial machinery to Argentina valued at nearly $6,500,000, as compared with about $4,800,000 in 1924, an increase of over one-third. Argentina is one of the important importers of American industrial equipment. As compared with 1913, the increase in exports to Argentina is even more striking, because the exports in 1925 were, in dollars and cents, three and one-third times those of 1913. The greatest increases in 1925 over 1924 were in oil-well and metal-working machinery, and in blowers and ventilators, power equipment and knitting machines. The value of metal-working machinery exported in 1925 to Argentina was $325,000, as compared with $215,000 in 1924. There has been a steady increase in the exports from the United States of metal-working machinery to Argentina since 1922.

* * *

SWEET MEMORIAL PROFESSORSHIP

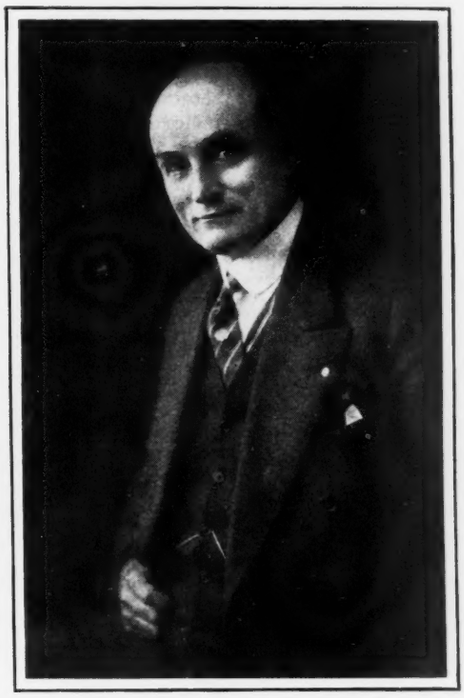
As a memorial to John Edson Sweet, founder of the American Society of Mechanical Engineers, and the first head of the College of Engineering at Cornell University and inventor of the straight-line engine, friends of Cornell University are raising a fund to endow a professorship at Cornell to be known as the Sweet Memorial Professorship. More than half of the amount required has already been subscribed.

Annual Meeting of Gear Manufacturers

THE tenth annual meeting of the American Gear Manufacturers' Association, held in Detroit, May 13 to 15, was marked by the usual interest in standardization and other association activities. In his opening address, the president of the association, E. J. Frost, president of the Frost Gear & Forge Co., Jackson, Mich., called attention to the fact that the rapid progress during the last two decades has called for vision and business daring of a most extraordinary kind, and recalled, in this connection, the story of the action of the school board of a little Ohio town nearly a hundred years ago, who, when the use of the school house was requested, so that certain topics might be discussed, answered: "You are welcome to use the school house to discuss all proper questions in, but such things as railroads and telegraphs are impossibilities and rank infidelity."

The All-important Question of Industrial Relationship

Having briefly dealt with questions of standardization, code of ethics, specialization, and other questions of interest to the association at the present time, Mr. Frost dealt at length with the question of industrial relationship. In so doing, he quoted from the late President Harding as follows: "The human element comes first, and I want the employers in industry to understand the aspirations, the convictions, the yearning of the millions of American wage earners, and I want the wage earners to understand the problems, the anxieties, the obligations of management and capital and all of them must understand their relationship to the people and their obligations to the people and their obligations to the republic. Out of this understanding will come the unanimous committal to economic justice, and in economic justice lies that social justice which is the highest essential to human happiness." "This," said Mr. Frost, "should be the text for the association."



E. J. Frost, Re-elected President of the American Gear Manufacturers' Association

Continuing, Mr. Frost said: "It has been quite common in the past for manufacturers to think in terms of their investments in material things, such as land and buildings, machinery and inventories of goods, either finished or in process, giving little consideration to that most vital item, human effort. The men of the shops do not want patronizing in the way of welfare work, club rooms, picture shows, reading rooms, and the like, unless they have a definite voice in their establishment, control, and support. What they crave is a just recognition of their part in the great economic structure, and a fair share of the returns.

"My observations lead me to believe that the men of the gear industry are above the average in their attitude toward labor, and this is one good reason why most of us can say, in all honesty of belief, that we have the finest body of workmen of any shops in our respective communities. Quoting the last two lines of one of Berton Brayley's poems: 'For man and master can be friends, if both are on the level.'

Unwise Business Expansion

"I was much impressed a short time ago by reading an editorial in the *Valve World*, in which the writer said: 'We expand our businesses in boom times for the primitive reason that good business makes us feel like expanding, and brings us the wherewithal. We retrench in dull times for the same crude reason—that we feel that way about it. Shrewd as we consider ourselves to be, we conduct our industrial affairs much as the stock-market "sucker" conducts his buying to our limit and beyond, at the top price, and selling at the bottom.'

"Perhaps we are altogether too much addicted to this sort of thing, and it may be so far-reaching in its effect as to be a potent factor in bringing on a slump in prices, due to the zeal of the unfortunates to justify purchases of land, buildings, or equipment made at the wrong time, by loading up with a volume of business that might better have been left alone.

"We should carefully study our expansions so as to buy when prices are the lowest, and more than all else, have equipment all set, ready to go when the wave of improved conditions come. Few of us, however, have nerve enough to do this.

"In closing, let me remind you that competition is keen, and there is no evidence that there will be any abatement. On the other hand, we owe it to the industry of which we are a part, and, to the extent that our product forms a part, to manufacturing in general, to so maintain the efficiency of our respective plants as to be able to contribute our share to the general progress when advisable by lowering prices and at the same time bettering quality. These things may, from time to time, be necessary to widen the markets that are our ultimate outlet, and in so doing we will contribute to the common good. And with it all, let us hold to the finer things of life by making business a means to an end rather than the end itself."

Obsolete Machinery in Manufacturing Plants

In an address entitled: "Are you using Pre-war Stuff?", Mason Britton, vice-president of the McGraw-Hill Publishing Co., Inc., called attention to the methods used by many large corporations in deciding upon the purchase of new machine tool equipment. He pointed out that the question of machine tool replacement is not an easy one to answer. Is a machine tool to be junked the minute another machine tool comes along that can do the work better? Is the answer to that question easy or complex? Sometimes it is easy, sometimes it is complex. It depends on how much better the new machine is, and it depends on a number of other things.

Every machine has two lives—an economic life and a physical life. What is the relation between the two, if any? What should be the limit of repair costs on a machine tool? How quickly should a machine tool pay for itself? One year? Two years? Five years? These are vital questions. They stand behind the whole efficiency of manufacture. Efficient machines are the essential link in the triumvirate materials, machines, men—which governs the industrial world.

"Recognizing the importance of this matter of machine replacements," said Mr. Britton, "the *American Machinist* investigated the practice of a score of nationally known manufacturers—their principles of machine replacement

and their procedure in maintaining the shop at the highest efficiency. These manufacturers agree on one fundamental thing. The primary step in keeping shop equipment up to date is to know exactly what each machine is producing and costing. Most of them maintain a complete card catalogue of every machine on the job, showing date of purchase, price, work it has been on, hours per week, transference to new work, if any, and list of all repair costs from the beginning. At the General Electric Co.'s plant in Schenectady there is a force of machine tool inspectors constantly watching the machine tools. Each inspector's job is to see that the machines under him are getting oil at the right time, that small breakdowns are repaired at once, and that the machines are taken out of service for overhauling whenever necessary; also to spot the machines that are not producing 100 per cent and to recommend that they be transferred, sold, or sent to the scrap heap.

How Quickly Must a New Machine Pay for Itself?

"Naturally, the industries that run their machine tools the hardest expect the machines to pay for themselves the quickest. Those that handle their machine tools more carefully give the machines more leeway in earning their cost. At one extreme are the automotive shops. Most of them insist that a machine tool pays for itself in one year. At the other extreme are the railroad shops: More careful handling, operating well inside the rated capacity, and an allowance of six or seven years for the machine to earn its cost. Other industries range in between these extremes. Says Mr. Hartman of the National Cash Register Co.: 'We will not overload our machines, believing that overloading is responsible for much of the discontent concerning machine tools expressed by some users.' He adds that whereas his company formerly demanded that a machine tool pay for itself in one year, they no longer insist on that. If they had, he says, there are many innovations in his shop that never could have been brought about.

"Another man in another shop crowds his machines all he can and explains the crowding policy in this way: 'Any machine tool has so much work in it. You can get all that work out in five or six years, or you can spin it along to fifteen or twenty years. But overhead is going along all the time whether the machine is working three-fourths of the rated capacity or one and one-quarter rated capacity. Machine designers are working night and day to beat that machine's accuracy and output. So why not cram the work through hard, get all you can out of it, and keep the proportion of productive output to overhead as high as possible?' The International Harvester Co. is for crowding to a reasonable maximum 'because of the rapidity with which machinery becomes obsolete,' and names two years as a favored time in which a machine should pay for itself. The Corona Typewriter Co. and the SKF industries also name two years."

Infections from Cutting Oils

A most instructive paper relating to means developed for overcoming infections from germ-laden cutting oil, was read by W. D. Price, Service Director of The Warner Gear Co., Muncie, Ind. This company, during the first ten months of 1925, experienced an epidemic of sixty infections, resulting in 900 days lost time and costing the compensation company many hundreds of dollars, one case alone amounting to nearly $1000. The compensation company was demanding relief. An increase of 25 per cent in premium rates was threatened; men were suffering and experiencing many sleepless nights and loss in wages; and the company was subjected to a resulting loss in production. Realizing the difficulties and appreciating its lack of knowledge on the subject, the Warner Gear Co. proceeded in its investigations, with the result that it was definitely ascertained that new oil is free from bacteria causing infections, but that the oil becomes germ laden while in use; and the problem was to find a substance which, if added to the oil, would prevent it from being contaminated. In this, the company succeeded, and infections from cutting oil have been practically eliminated from the plant. [Preparations that will destroy germs in cutting oil contain, we are informed, tar acid in liquid soap. Such preparations may be obtained from the Sulpho-Napthol Co., 14 Medford St., Boston, Mass., or from Frederick Stearns & Co., Detroit, Mich.—Editor]

The germ destroyer used is added in the proportion of one per cent to all new oil used for the machines, except in the case of hobbing machines, where the working temperature is some 20 degrees higher and burns out the agent more quickly. These machines require special attention, and one per cent is added between oil renewals.

Gear Tooth Stresses and Wear of Gear Teeth

A paper on "Gear Tooth Stresses" was presented by S. Timoshenko and R. V. Baud, research engineers of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. In this paper, stresses and deflections in gear teeth were discussed. By using the photo-elastic method, the stress concentration at the tooth root has been studied, and the factors of stress concentration established for various radii of the fillet. By using the Herz theory, the local stresses at the surface of contact of two teeth in mesh were examined, and it has been shown that the most unfavorable conditions take place at some depth beneath the surface of contact. Equations were given for calculating the deflection of teeth, and it was shown that this deflection is usually less than the inaccuracies in commercial gears.

Professor Earle Buckingham, of the Massachusetts Institute of Technology, Cambridge, Mass., read a paper on "Wear of Gear Teeth." This paper is abstracted on page 798 of this number of MACHINERY. At the annual dinner of the association, William B. Stout, president of the Stout Metal Airplane Co., made the principal address, dealing with the development of transportation, its influence on civilization, and the new era ushered in by the coming of air transportation.

Standardization and Research Work

Practically all of the association's many standardization committees presented progress reports. An interesting record was presented of the research made at the Massachusetts Institute of Technology on the gear testing machine installed there. The report on a formula for horsepower computations for non-metallic gearing, was accepted as recommended practice of the association.

Election of Directors and Officers

Four directors, to serve three years, were elected: A. W. Copland, president, Detroit Gear & Machine Co., Detroit, Mich.; R. P. Johnson, president, Warner Gear Co., Muncie, Ind.; George L. Markland, Jr., chairman of the board, Philadelphia Gear Works, Philadelphia, Pa.; and B. F. Waterman, engineer, Brown & Sharpe Mfg. Co., Providence, R. I.

The officers for the coming year were all re-elected: E. J. Frost remains president; A. F. Cooke, vice-president, Fawcus Machine Co., Pittsburg, Pa., is first vice-president; B. F. Waterman is second vice-president; and C. F. Goedke, secretary, William Ganschow Co., Chicago, Ill., is treasurer. T. W. Owen, 2443 Prospect St., Cleveland, Ohio, is secretary.

The following new member companies were elected: Accurate Gear Corporation, Brooklyn, N. Y., Joseph J. Braun, Jr., executive member; Pratt & Whitney Co., Hartford, Conn., H. D. Tanner, executive member; and Warner Corporation, Muncie, Ind., B. E. Johnson, executive member. The association now has eighty-four member companies.

* * *

The entire production of the fifty-two automobile plants in Germany in 1925 was approximately 60,000 cars, or about 1150 cars per factory. The total capacity of the German automobile industry is estimated at 100,000 cars a year. In 1924 there were eighty-six automobile factories in Germany, listing over 50 per cent more models than in 1925.

Industrial Machinery Exports in 1925

By W. H. RASTALL, Chief of the Industrial Machinery Division, Bureau of Foreign and Domestic Commerce, Washington, D. C.

EXPORTS of industrial machinery from the United States in 1925 totaled almost $150,000,000, representing an increase of 14 per cent, as compared with 1924, which, in turn, was 6 per cent above the figure for 1923. There has been a consistent increase in exports of industrial machinery from the United States since 1922.

Although it is probably true that it is impossible to export to some countries certain types of American machinery, because foreign manufacturers are able to produce them at lower costs, this situation does not reflect the position of American machinery exports in general, for the volume of these exports is very much in excess of that of pre-war years. Even allowing for the increased prices charged for machinery, it would appear that the tonnage now being exported is considerably in excess of the pre-war tonnage, while exports from Germany and the United Kingdom have not yet reached the pre-war volume. In 1925, the United Kingdom purchased nearly $19,000,000 worth of machinery from the United States, and Germany took nearly $6,000,000 worth—facts that are a splendid testimonial to the value and importance of American designs.

It is true that some time ago when the mark was depreciating, German manufacturers were able to offer machinery on the world's markets at prices very much below American costs, and that in certain instances this situation may continue. However, since the stabilization of the mark and the inauguration of the Dawes plan, German costs have been rising, and this competition has been less serious. There has been similar abnormal competition from certain European countries. Gradually these abnormal conditions are being eliminated, and as stability approaches, American manufacturers are seen to have a position that is much more favorable than in pre-war years. In this connection, it should be added that in earlier years German manufacturers frequently sold machinery on credit, but during 1925 German interest rates were high, and banking conditions were such as to make these operations very difficult. It is expected that credit operations from German sources will not introduce serious competition for some time to come.

In the United Kingdom, the unemployment situation has caused manufacturers to bend every effort toward securing export business, but in general, the British business situation has been confused, and manufacturers have found it exceedingly difficult to do business in non-British markets overseas. There is reason to believe that British manufacturers have felt German competition far more seriously than those of this country. American prospects are very good.

For the last three years, Latin America has absorbed a larger part of our machinery exports than any other section of the world, and particular attention is called to the rapidity with which exports to Latin America have increased—this expansion being from $18,825,000 in 1913 to $52,433,000 in 1925. This increasing use of modern types of machinery in Latin America is quite significant. It is also a fact of some importance that during the years when the exports of machinery from the United States were at a maximum, the participation of the Latin American countries in this expanded volume was comparatively small, while later demand increased. Development was evidently in some degree interrupted by the abnormal conditions of the war, but now that the world has been relieved of some of these conditions, the countries to the south of us are in a position to resume their natural development, and, as a consequence, in the last three years, the Latin American demand for machinery from this country has been more persistent than in any earlier time. Latin America is now taking about 35 per cent of our machinery exports.

Shipments to Asia are also very significant. Contrasted with a value of about $4,000,000 in the pre-war period, the total is now approximately $16,500,000. Unlike the experience with Latin America, this volume is shrinking, which is the more unfortunate because there is reason to believe that this

WORLD MARKETS FOR AMERICAN METAL-WORKING MACHINERY

According to Figures Compiled by the Industrial Machinery Division of the Department of Commerce

Country	Value 1925	Value 1924	Value 1923	Value 1922
United Kingdom	$4,053,267	$3,128,208	$2,451,499	$2,146,554
Germany	2,986,434	545,315	209,474	77,120
France	2,429,269	2,058,521	1,091,967	1,034,532
Canada	2,328,409	1,751,692	2,956,589	1,640,905
Italy	1,724,504	304,376	142,263	82,157
Japan	1,204,733	1,981,033	1,484,618	1,480,777
Russia in Europe	887,923	227,972	30,622	930
Australia	840,796	639,749	638,618	415,830
Mexico	557,106	352,279	585,728	449,469
Chile	485,160	213,494	187,977	206,324
Netherlands	365,103	201,532	123,859	52,562
British India	361,576	336,914	717,757	2,404,884
Argentina	324,803	214,889	204,321	158,556
Spain	323,135	324,020	280,350	229,745
Cuba	309,160	345,761	382,640	238,199
Sweden	301,862	155,492	111,591	31,039
Brazil	299,458	187,082	199,889	240,666
British South Africa	268,791	222,765	139,353	62,186
Czecho-slovakia	256,832	56,453	26,326	8,770
Colombia	243,818	76,544	66,617	77,676
Belgium	183,792	192,488	220,680	163,105
Venezuela	127,564	66,502	63,011	72,089
New Zealand	87,510	106,686	85,962	70,360
Dutch East Indies	85,374	48,146	22,553	14,471
Peru	81,718	119,749	79,011	74,664
Panama	70,056	47,069	26,972	10,820
Switzerland	66,482	43,227	28,514	8,996
Philippine Islands	53,309	73,637	44,968	57,771
Persia	48,822	12,312	7,841	968
Dominican Republic	48,245	14,760	16,717	8,769
China	46,055	51,345	76,095	319,237
Norway	45,838	22,885	34,295	23,973
Greece	34,243	2,259	2,101	755
Uruguay	27,576	17,476	16,788	6,622
Portuguese East Africa	26,403	5,749	9,655	2,887
Finland	25,715	10,959	16,219	3,515
Honduras	25,703	42,260	38,935	24,284
Salvador	22,381	8,924	2,599	4,070
Denmark	21,634	30,402	35,590	23,593
Austria	20,958	5,735	1,097	.....
Straits Settlements	20,701	34,941	7,354	12,532
Guatemala	20,668	17,048	18,575	10,310
Hungary	20,493	224	11,065	20
Poland	20,144	5,486	12,071	54,962
All other countries	253,273	285,151	193,860	201,464
Total	$22,036,796	$14,589,511	$13,104,586	$12,209,138

Machinery

reduction is the result of unsatisfactory conditions in Asia, and not because Asia has less need for industrial equipment than Latin America. Reports reaching the Department of Commerce indicate that Asia is in great need of industrial equipment, but that political, economic, and other conditions frequently make it difficult to establish industries there and purchase the equipment needed. Fortunately, it would seem that these restraints will prove to be only temporary. It would appear that American manufacturers are justified in giving careful attention to the possibilities of all the Asiatic and Latin American markets.

Europe is undoubtedly the best market for those types of machinery used in manufacture—so-called "production equipment." The volume of machinery shipped to Europe has increased consistently since 1922; it is now nearly double the volume of that year, and gives evidence of further increase. Our best customers there are the United Kingdom, Germany, and France, which are usually considered our most serious competitors. It is quite significant that the value of American machinery absorbed by Germany increased from a total of $763,000 in 1923 to $5,931,000 in 1925. If Germany is able to attain a more satisfactory economic position, this volume can be expected to mount quite rapidly. It should also be noted that the volume of machinery shipped to the United Kingdom expanded from $12,791,000 in 1922 to $18,879,000 in 1925.

In earlier years, Italy did not rank very high as a machinery market, but the amount of equipment shipped there has been growing rapidly, increasing from $559,000 in 1922 to $3,811,000 in 1925. Italy is being industrialized, and water power properties in that area are being developed quite rapidly. Italian manufacturers of various products find that they are able to compete successfully in the world's markets, and it would appear that further industrial expansion may be anticipated. The situation in Russia is particularly interesting, the volume of our industrial machinery absorbed expanding from $64,000 in 1922 and $956,000 in 1924 to $3,678,000 in 1925.

Canada is almost invariably our best market for industrial machinery, and apart from the abnormal experiences of 1919 and 1920, Canada has long purchased between $20,000,000 and $30,000,000 worth of machinery from this country each year. The United Kingdom ranks next in importance. Both Cuba and Mexico are close to the United States, and have long absorbed a large volume of our machinery. Argentina ranks next in importance, and imports more equipment from the United States than any other South American country. It is developing rapidly in a variety of ways, and while the character of machinery shipped there probably differs radically from the types shipped to Europe, it would appear that for many classes of equipment the Argentine market ranks very high.

British Machinery Exports and Imports

In the year 1925, the United Kingdom imported nearly $43,000,000 worth of industrial machinery; of this amount, the United States furnished about one-third. The tonnage of these imports equals about 88 per cent of the imports in 1913, although their value, expressed in dollars, is more than double that of the imports in that year.

The British imports for 1925 increased 21 per cent in tonnage and 14 per cent in value, as compared with 1924. They were also approximately 12 per cent, both in tonnage and value, in excess of those for 1923. The imports of machine tools were valued at approximately $3,500,000 in 1925, as compared with $2,700,000 in 1924, and $2,450,000 in 1923. The exports of machine tools from Great Britain in 1925 were valued at approximately $7,500,000, as compared with $6,700,000 in 1924, and $6,000,000 in 1923.

The Machinery Trade of Germany in 1925

The German machinery imports for 1925 were almost three times as large, in tonnage, as those for 1924. There was also a large volume of export business in 1925. The total imports of all machinery into Germany, including both industrial and agricultural, but excluding electrical equipment, were valued at about $18,000,000. The tonnage was 38,400, as compared with 13,300 tons in 1924. The imports in 1913 were 87,900 tons. The total exports of machinery from Germany, including equipment of all kinds, amounted to 369,000 tons, valued at approximately $160,000,000. In 1913 the exports amounted to 596,000 tons.

Industrial Machinery Market of Sweden

The latest figures available showing the Swedish imports of industrial machinery are for 1924. During that year the imports were valued at approximately $4,500,000. The United States supplied 18 per cent of these imports; Germany, 44 per cent; Denmark, 14 per cent; and Great Britain, 13 per cent. The imports from the United States increased from $714,000 in 1923 to $807,000 in 1924. Of the machinery imported in 1924, metal-working machinery accounted for about $400,000, an increase of about 40 per cent over the imports in 1923. The United States supplied 28 per cent and Germany 54 per cent of these imports. The exports of industrial machinery from Sweden in 1924 were valued at about $12,000,000. Sweden's position as an industrial country may be measured by its industrial production during 1924, which was valued at approximately $1,204,000,000.

French Machinery Exports

The manufacture of machinery in France in 1925 was characterized by a high degree of activity. The developments in the exchange situation assured domestic manufacturers of a good home market, discouraged imports, and encouraged exports. The shipments of industrial machinery from France, by weight, were nearly double those of 1913. Imports of machinery in general were reduced, but foreign-made machine tools continued to be in fair demand.

The Machinery Trade of Czecho-Slovakia

The machinery imports of Czecho-Slovakia during 1925 increased greatly over the previous year, while the exports decreased slightly. The imports were valued at approximately $14,250,000, an increase of 65 per cent over 1924. The exports were valued at about $12,000,000, a decline of about 13 per cent.

* * *

MEETING OF ASSOCIATION FOR COOPERATIVE EDUCATION

An association has recently been formed by American colleges and universities giving cooperative instruction in engineering, commerce, architecture and other subjects. The first annual meeting of the association will be held on June 14 and 15 at the University of Cincinnati. Cooperative courses have been established in many colleges, both in the United States and in foreign countries. Under the cooperative plan, the students spend alternate periods at the university and at work in industry. While one student is in school, his alternate is receiving practical training in some factory or office, and vice versa. The theory learned in the classroom is thus applied in industry, and the problems that arise in industry are brought to the classroom. At the meeting in Cincinnati a program will be presented dealing with various phases of educational work in college and industry and with the cooperation between the two. The principal subject for discussion will be that of methods for bringing about closer and more effective cooperation between the college and the employing firms. Details of operation and administration will be considered.

* * *

It is general practice in drilling holes in automobile engine parts, to locate all holes from dowel holes that are drilled first and that serve as a reference for drilling every other hole in the casting. In one automobile shop recently visited, a different method is in use. The tap and bolt holes are located from the dowel holes as usual, but important holes that have to have a specific relation to some other hole, are located from the hole to which they must bear a definite relation. It has been found that by this method greater precision is obtainable.

Design and Use of Salt Bath Furnaces

By MILTON EPSTEIN, Industrial Engineering & Equipment Co., St. Louis, Mo.

SALT bath heating mediums have been given a great deal of attention by metallurgists for many years. The different salt baths known by the trade name "Lavite" at present occupy a prominent position in this field. The furnace problems encountered in the development of the salt bath process were especially intricate, and progress was delayed on account of this for some time; but designs of furnaces have now been developed that make it possible to perform, by means of salt bath heating mediums, all heating operations from the drawing of temper, at 500 degrees F., to the heating of high-speed steel for hardening, at 2300 degrees F.

MILTON EPSTEIN was educated in the public schools of Denver, Col., and spent two years at Denver University. He then entered the Carnegie Institute of Technology at Pittsburg, from which he graduated with the degree of Bachelor of Science in Chemical Engineering in 1920. Later, he was with the People's Gas Light and Coke Co. of Chicago for two years, and with the Laclede Gas Light Co. of St. Louis for three years, his work consisting of sales and development work in the industrial gas field, including the design and installation of furnace equipment for the more common as well as for a great many special industrial heating operations. About a year ago, Mr. Epstein entered into partnership with J. J. Lynch, specializing in equipment for the industrial furnace field. Their work has been carried on largely in the metallurgical industries, particular attention having been paid to the heat-treatment of tool steel.

Main Considerations in Salt Bath Furnace Design

There are a number of important points that must be observed in the design of equipment for salt bath heating operations. Pot furnaces are the only type suitable for this class of work, and such furnaces have now been constructed for temperatures covering the entire range of heat-treating operations; but unless special precautions are observed, trouble with pots under such severe usage, particularly in the upper part of the temperature range, will result.

The pot should have sufficient capacity to prevent too great a temperature drop when cold steel is immersed in the bath. Circular pots should be employed whenever possible, as these permit of more uniform heating. The burners should not strike against the pot, as in that case it will burn out at the point where the flame impinges upon it.

The burners should be placed at the top of the furnace and the vent at the bottom, for two reasons: (a) The point of maximum heat dissipation is at the surface of the bath, because here there is direct radiation into the air; the point of maximum input of heat should be at the top, so that the heat may be applied most rapidly at the place where it is most rapidly dissipated. (b) In melting the salt, there is expansion, and if the melting is started at the top, plenty of room is provided for expansion and unnecessary strains on the pot are avoided. Provision should be made for reclaiming the waste heat by using it for preheating the work to be treated. Equipment is now available on the market embodying all the stipulations of design mentioned in the preceding paragraphs.

The question of fuel is largely a matter of local conditions and fuel prices. In most large cities where gas is available at reasonable rates, it should be given preference. It may be considered as the logical heating medium for most salt bath furnaces. Oil fuel has also been used successfully, and should be employed for all larger types of furnaces, as well as in cases where gas is not available, or where the price of gas is too high.

Occasionally it is necessary to use pots of other than circular shape. Fig. 1, for example, shows a carbon steel furnace which is used for hardening a certain type of dies. Some of these dies are as large in their outline dimensions as the pot itself, and are rectangular. For dies of this shape, a rectangular pot exposes much less radiating surface than would a circular pot large enough for the immersion of these dies. As only the cutting edge is heated to a depth of 1/4 inch, the volume of the steel heated is small, and a shallow pot has sufficient capacity to prevent any large temperature fluctuations. Fig. 2 shows the latest design of rectangular furnace.

Heat-treatment of High-speed Steel in "Lavite" Bath

A furnace for high-speed steel should be provided with three pots, as shown in Figs. 3 and 4. The center one is intended for the high heat, and is maintained at a temperature of about 2300 degrees F. One of the side pots is used for preheating the work to from 1600 to 1800 degrees F., and the other side pot is used for quenching, being maintained at a temperature of from 1100 to 1200 degrees F. Waste heat from the center pot is used for heating the two side pots, although these are also equipped with auxiliary burners. The work is first preheated, and when it has reached the preheating temperature, it is transferred to the high-heat pot. It is then withdrawn from this pot and quenched in the third. No scaling takes place, because of the thin film of salt that adheres to the steel when it is removed from the high-heat to the quenching pot.

Fig. 3 shows in detail how the three-pot high-speed steel furnace is designed.

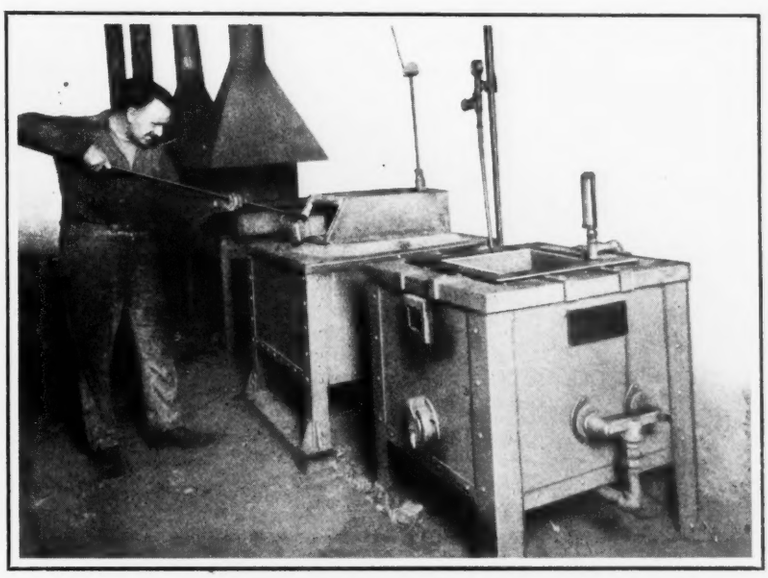


Fig. 1. Salt Bath Furnace for Carbon Steel shown in the Foreground

It can readily be appreciated that a difficult task confronts the designer who is to produce a furnace that will heat steel to a temperature of 2300 degrees F. in a pot filled with a salt bath, by heating the exterior of the pot. Temperatures of from 2600 to 2900 degrees F. must be developed in the combustion chamber. At these high heats the carbon dioxide of the flue gases will scale steel, and if there is excess oxygen scaling is accelerated.

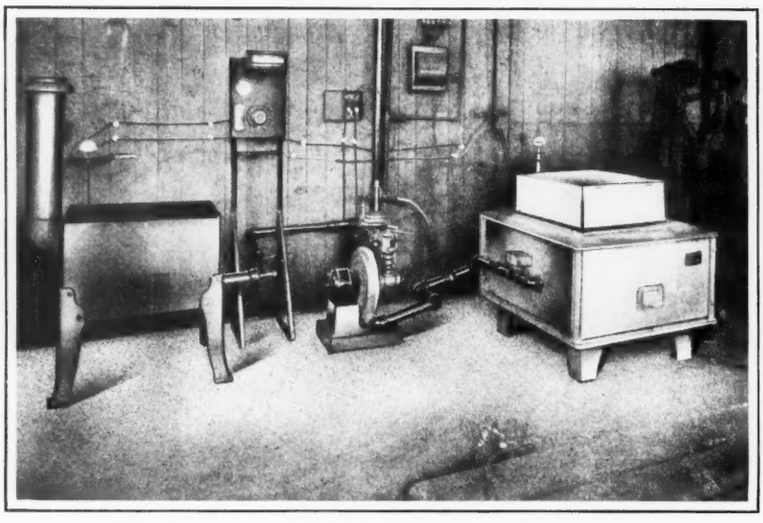


Fig. 2. Latest Type of Rectangular Salt Bath Furnace

The first furnaces built for heating high-speed steel were designed to heat the pot by methods that had been developed for cyanide and lead hardening furnaces. In these furnaces, the pots burned out before the high temperatures required for high-speed steel were approached. The present construction was evolved with the main idea of allowing no flue gases to come in contact with the pot. A carborundum sleeve, into which the pot fits closely, affords a means of transmitting the heat while still protecting the container. This sleeve is about 1/2 inch thick, and due to the high refractory power and conductivity of carborundum, the pot containing the salt is heated by an even radiation from the carborundum sleeve.

Trouble has also been experienced with the pots oxidizing rapidly on the inside at the salt line, because here the air can attack the metal, and at a temperature of 2300 degrees F. oxidation is very rapid; hence, the containers were cut through in a short time. This difficulty has been avoided by the simple expedient of placing a steel collar about 6 inches high on the inside of the pot, and allowing it to dip a few inches into the salt. The collars can be replaced very easily and at low cost. Fig. 3 shows the carborundum sleeve at *A*, the pot at *B*, and the collar at *C*. The collar is not shown in Fig. 3.

By treating high-speed steel with the "Lavite" salt bath process, remarkable results have been produced, as regards the endurance of tools between grinds. The endurance of turbine blade cutters was increased from 160 pieces per grind to 900 pieces per grind. A thread cutting tool, which only by extreme care would thread 600 pieces per tool, after being treated by the salt bath process, has stood up for as many as 36,000 pieces—which is far beyond any performance believed possible.

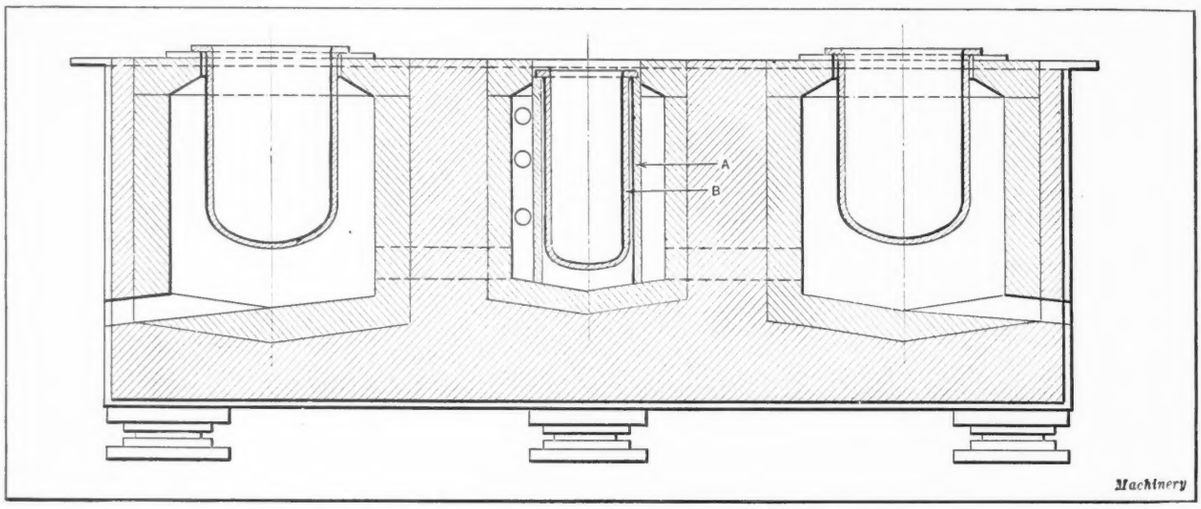


Fig. 3. Section of Salt Bath Furnace for High-speed Steel

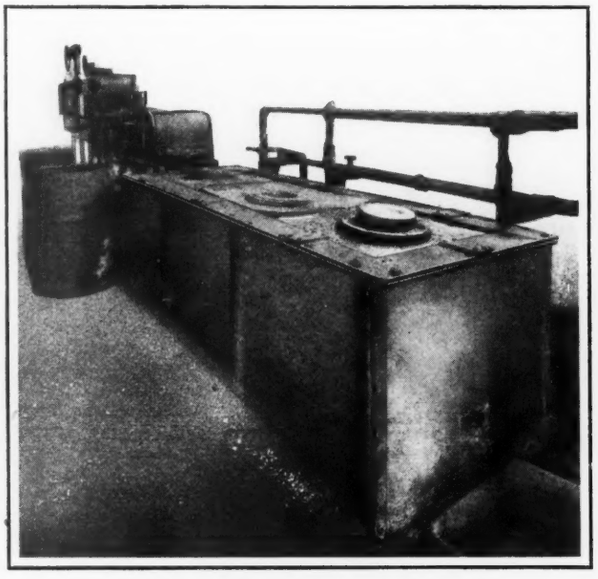


Fig. 4. Salt Bath Furnace for High-speed Steel

Comparison between "Lavite" and Lead Heating Baths

A "Lavite" bath transmits heat to steel in a manner quite different from a lead bath or an oven furnace. As a lead bath is similar to a salt bath in regard to heating conditions, a comparison will be made between these two methods. The differences can best be explained by a consideration of the physical properties of the two heating mediums, as shown by the accompanying table.

A piece of steel immersed in a carbon-steel "Lavite" bath is brought up to the required temperature at a uniform rate. This desirable heating effect is produced in an interesting manner. When the steel is introduced into the bath, the "Lavite," which

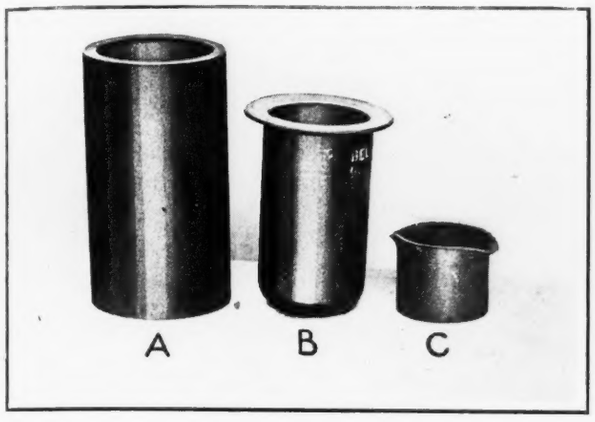


Fig. 5. Carborundum Sleeve, Salt Bath Pot, and Inside Protecting Collar for High-speed Steel Furnace

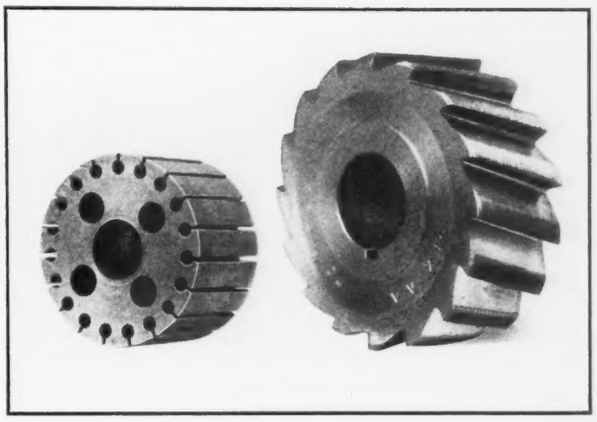


Fig. 6. (Left) High-speed Steel Lamination Die; (Right) High-speed Steel Threading Hob heat-treated in Salt Bath Furnace

has a melting point of 1300 degrees F., freezes around the steel, and forms an insulating jacket which prevents too rapid transfer of heat in the initial stages of the heating period. This jacket is also slow in melting, and the composition of "Lavite" is such that the melting of the jacket proceeds at a rate that permits of a uniform transmission of heat to the metal. The high specific heat of "Lavite" and its high heat of fusion account for the slow rate at which the insulating jacket melts. When the temperature of the steel has reached 1300 degrees F., the jacket has entirely disappeared, and at this point also, there is a favorable condition for heat transfer, because the temperature difference between the steel and the bath is comparatively small. Beyond 1300 degrees F., the full heating effect of the bath is obtained, and this effect is enhanced by the low viscosity of the salt bath, which permits free circulation of the heated salt around the steel.

With lead, no insulating jacket—or at best a very thin jacket—is formed. This is due to the low melting point, the low latent heat of fusion, and the low specific heat of lead; hence, the slow and uniform heating obtained with "Lavite" is not possible in a lead bath. A comparison between the heating rate in an oven furnace, in a "Lavite" pot furnace, and in a lead pot furnace is shown in Fig. 7.

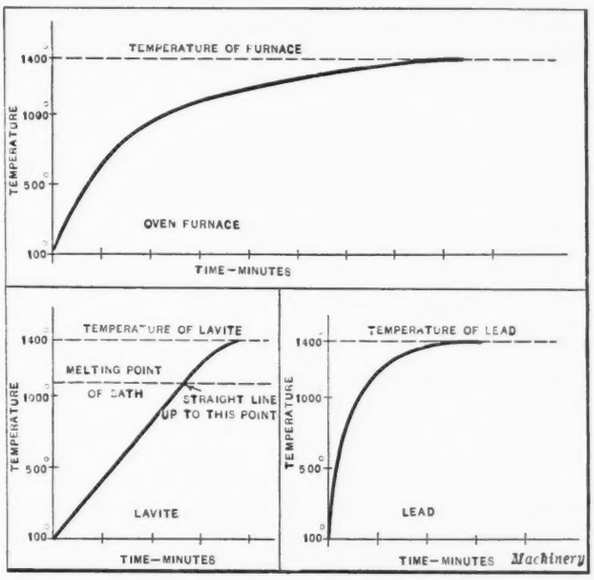


Fig. 7. Heating Curves for Tools heated in Oven Furnace, in "Lavite," and in Lead Pot

Figs. 8 and 9 show a number of intricate dies that have been successfully heat-treated in "Lavite" furnaces. Fig. 6 shows a high-speed steel lamination die on the left, and a high-speed steel thread hob on the right, that have been treated in this type of furnace.

PHYSICAL PROPERTIES OF "LAVITE" AND LEAD

Physical Properties	Carbon-steel "Lavite"	Lead
Melting point	1300 deg. F.	621 deg. F.
Specific heat	0.21	0.032
Latent heat of fusion	High	Low
Specific gravity	1.9	11.37
Viscosity	Low	High

* * *

FIRST AID ROOMS IN SMALL PLANTS

The Policy-holders' Service Bureau of the Metropolitan Life Insurance Co., New York City, has published a booklet entitled "First Aid Rooms in Small Plants," which contains valuable information for those who wish to install an inexpensive and yet adequate first-aid room of a size suitable for a comparatively small plant. The booklet specifies the size of room required, the equipment needed, records that should be kept, and the training that a person should have to take charge of a first-aid room when there will not be a trained nurse or doctor in regular attendance.

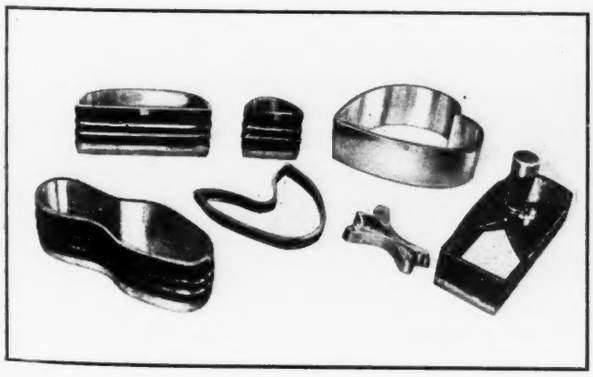


Fig. 8. Collection of Dies of Intricate Shape heated in "Lavite" Furnaces

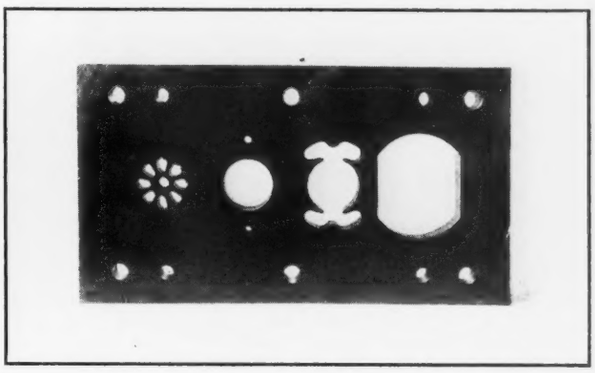


Fig. 9. Another Die with Many Openings heated for hardening in "Lavite" Salt Bath

Notes and Comment on Engineering Topics

According to *The Valve World*, the new high-school building at Pagosa Springs, Col., is heated with natural hot water from an artesian well 350 feet deep. The building contains about 7000 square feet of radiating surface, which, owing to the lower temperature of the well water, is practically double the radiation that would be required for artificial heat.

The largest synchronous condenser ever built is stated to be a 40,000 K. V. A., 600 R. P. M., 11,500 volts, three-phase, 60-cycle machine placed in operation last year by the Westinghouse Electric & Mfg. Co. One of the interesting features of this machine is the fact that its total losses at rated output are only 2 per cent of its rating. It is pointed out that this represents an efficiency for rotating machinery that compares very favorably with that of transformers.

A thermometer that may be graduated so as to give reliable readings up to at least 1000 degrees C. (1832 degrees F.) has been devised by Sylvester Boyer of the Thomson Research Laboratory of the General Electric Co. The element gallium is used in the thermometer; it is sealed in a capillary tube of fused quartz of uniform bore, after which the thermometer is calibrated and graduated. Gallium melts at 29.7 degrees C. (about 85 degrees F.) and boils at approximately 1700 degrees C. (about 3100 degrees F.).

In mining, great improvements can be made in the methods of handling materials under ground. It is estimated that in the coal mining industry, which produces annually about 400,000,000 tons, or more than 30 per cent of the total tonnage of all industries combined, over 90 per cent of the coal mined carries a burden of from 40 to 60 cents per ton for hand shovel labor. The new developments in the electric motor field resulting in an electric motor that will operate with safety in an atmosphere charged with inflammable gases, is likely to give a decided impetus to mechanical handling methods in underground mining operations.

An old boiler made in 1853—seventy-three years ago—is still in use working continuously day and night at one of the Clydeside factories in Scotland. It is regularly inspected by a boiler insurance company, and the proprietor states that he has never received an adverse report on the boiler, nor has it ever required any repairs since it was set to work. The boiler is of the Lancashire type, and is now working at a low pressure. It is constructed entirely of iron plates. The end plate is made in halves, as a sheet of metal large enough for the end could not be rolled at the time the boiler was constructed.

The efficiency of the oil-electric locomotive—the most recent development in the motive power field—was, according to a statement issued by the Ingersoll-Rand Co., strikingly demonstrated in a recent series of tests made by the Central Railroad of New Jersey. A 60-ton oil-electric locomotive, in terminal service, handled a total tonnage of 61,556 in 347 hours, at a total fuel cost of $72.58. A steam locomotive, operating under almost identical conditions, rendered 297 hours service in twenty-four days, and during this time moved a tonnage of 50,493 at a cost for fuel and oil of $349.46. The cost of fuel per 1000 tons handled was $1.16 for the oil-electric locomotive, as compared with $6.92 for the steam locomotive. The saving in fuel costs, it is stated, is only one of the many economies made possible by the oil-electric locomotive.

A British company known as Television, Ltd. (Motograph House, Upper St. Martin's Lane, London) has been able to transmit electrically over short distances crude images of living and moving objects. A demonstration of this apparatus was recently given. A recognizable human face, for example, was transmitted, and the movements of the eyes and mouth were clearly visible. The transmission, so far, has taken place only over a short length of wire, from one part of a room to another. Wireless transmission has not so far been attempted. Now that the first difficulties of the transmission of images of living and moving objects have been overcome, it is likely that the development of the process, both by wire and by wireless transmission, will not present insuperable difficulties.

In an article in *Mechanical Engineering*, attention is called to the large number of self-propelled passenger cars now used on many railroads. This type of passenger car is coming more and more to be recognized as a satisfactory and economical means for carrying passengers on branch lines. The early cars of this type were practically adaptations of highway buses. The present tendency is toward the use of larger equipment, which introduces numerous problems in the design of power plant and transmission. Electric, hydraulic, and gear drives are all being employed in this service. An interesting innovation which has developed in England and is now being tried in this country is the so-called "articulated" car with two bodies mounted on three trucks, or three bodies mounted on four trucks, one unit now being in operation on the Brooklyn Rapid Transit Lines.

Two methods of producing ductile welds have been developed by two research scientists of the General Electric Co., working in different laboratories at Schenectady, N. Y. and at Lynn, Mass. The methods are similar in some respects and mark a new step in the utilization of the heat of the electric arc in joining metal parts. Dr. Irving Langmuir developed one method at the Schenectady Research Laboratory, while Peter Alexander developed the other at the Thomson Research Laboratory in Lynn, Mass. In both processes, air is excluded from the metal by means of a bath of hydrogen or other gas while the welding takes place. The formation of oxides and nitrides in the welded metal is thus prevented, and it is stated that the fused metal is as strong and ductile as the original metal. Complete details of these new methods of arc welding are to be found in the March number of the *General Electric Review*, published at Schenectady, N. Y.

An article entitled "The Miracle of the Modern Freight Train," in the *Executive's Magazine*, calls attention to the great importance of rapid and dependable freight movements in the progress of our present-day civilization. It is mentioned that in 1776 there was regular freight service by wagon between London and Edinburgh, a distance of 395 miles. Each wagon was drawn by eight horses, and accompanied by two men. The load was about four tons. The 395-mile trip consumed twenty-one days. This was an average of just under nineteen miles a day. In 1925, there was through freight service between New York and San Francisco in eleven days. The distance is 3140 miles. The average distance covered is 285 miles a day. This is exactly fifteen times as far as the day's run of the "fast freight transportation" of 1776. There are other differences between the transportation of 1776 and the transportation 149 years later. Then, two men had charge of four tons. Today, five men have charge of 2000 tons.

What MACHINERY'S Readers Think

on Subjects of General Interest in the Mechanical Field

COSTLY MISTAKES IN THE SHOP

I read with a great deal of interest the article "Costly Mistakes in the Shop" on page 374 of January MACHINERY. Experience as a shop foreman during the past twenty-three years leads me to give some of my views on this question. In the first place, it may be said with considerable truth "the man who never makes a mistake in the shop never makes anything." There is, however, no reason why costly mistakes cannot or should not be considerably lessened in our industrial establishments by efficient management, not only in the shop but also in the designing and material requisitioning departments.

I have known of several mistakes, made in requisitioning material, that cost the company very large amounts. It is suggested that, when requisitions are made by clerks for any great quantity of material, the order should be checked by the shop foreman of the department for which the material is ordered. The inaccurate dimensioning of drawings is another source of unnecessary expense. In some cases, designs worked out in the engineering department or drafting-room are found impracticable when actual construction is attempted, with the result that a considerable loss is involved.

I agree with the remarks in the article in January MACHINERY regarding the practice of calling the workman's attention to the actual money value of the loss resulting from a mistake he has made. I believe there is nothing that impresses a workman more forcibly than to have the cost of a mistake, in dollars, called to his attention. Also I am of the opinion that if the workmen only knew the value of the materials handled, much greater care would be taken in their use. It may be argued that it would be against the employer's interests to let the price paid for materials be generally known among the workers. While this may be the case in some instances, I believe that there are many times where the lack of this information results in unnecessary waste of material. It is often said that we learn by making mistakes. The wise man, however, doesn't make the same mistake twice, nor does he knowingly repeat mistakes made by others.

E. A.

MAKING POWER PRESS OPERATIONS SAFER

Devices for protecting the workmen's fingers from injury are in general use in shops where a large number of presses are employed. Some of these devices are designed to feed the work to the dies and thus eliminate the necessity for placing the hands in the danger zone. Safety devices are not in common use, however, in the general run of small shops where only a few presses are employed. The superintendent of one small shop recently said, "We don't use this press every day and the orders we put through on it are all small ones. It would not pay us to bother with a safety attachment."

The various safe methods that can be used for feeding work to dies are unknown in many small shops and it is not uncommon to see an operator in a small shop feed work to the dies of a power press with his fingers. Permitting an operator to do this in such a manner that his fingers come directly under the punch is dead wrong. It is not fair to the operator nor to the company. When an operator loses a finger in a power press, the finger can never be replaced, and the feeding of work to the dies in this manner always slows up production, which is a disadvantage to the company.

There are any number of safe methods of feeding work that do not require the operator to place the work in the dies with his fingers. A practical method which is not only safe for the operator but which will also increase production, is described in the following. With this method the blanks, which we will assume are to be flattened, are held in a tray in front of the flattening die and are fed to the die from the tray with a stick or soft metal pusher held in the hand. After the blank has been flattened, it is pushed from the die into a box at the rear of the press, and a new blank is pushed into place. If the press is not of the open-back type, a chute made of tin can be placed at the back of the die which will allow the flattened blanks to slide down into a box at the side of the press.

The tray referred to may be so designed that it can be used for different punch-press jobs. The angle-piece to which it is attached can be fastened to the bench if the press is of the bench power press type, or it can be secured to the bed of the press by two screws which pass through a slot at the lower end of the angle-piece. The slot permits the tray to be raised or lowered to bring it flush with the top of the lower die. When the tray is properly adjusted, the operator can easily slide the work from it to the proper position on the die.

CHARLES DOESCHER

STANDARD VERSUS SPECIAL MACHINES

The writer believes that in many cases special machines are built for purposes where standard machine tools, with some ingenuity displayed in applying the tool equipment, would do the work equally well and possibly cheaper. Enormous sums are being spent on developing special machines for purposes where it would seem that standard machine tools would give about the same production, unless the production is remarkably great. Furthermore, there is greater flexibility in standard machine tool equipment and the breakdown of one machine is not so serious as the breakdown of a high-production special machine. Of course, each case must be judged on its merits, and the foregoing is written merely to call attention to the possibilities of standard machine tools, so that in every case where a special machine is considered, standard machine equipment will also be given fair consideration. Then the type that is best suited for the purpose, all conditions being considered, may be selected.

OBSERVER

CORRECTING ERRORS IN THE SHOP

I was very much impressed by the method of correcting errors that I recently saw applied in a plant in western Illinois. The works manager, in passing through the shop, noticed one of the men having difficulty in manipulating a jig. It was quite obvious what the trouble was, and the works manager might have corrected the man in a couple of minutes and told him how to proceed with the work. But instead of doing this, he went on through the shop, and when he met the foreman, he mentioned to him that he had observed that a certain man was having trouble with the operation of a jig, leaving it to the foreman to deal directly with the man.

This works manager knew how to maintain respect for his foremen. He recognized that all orders and directions should come from the foreman and not from anyone else in authority. The entire plant gave evidence of the same definitely planned system of management throughout. Everybody knew what his duties were and from whom he should take orders.

G. F.

CHAPLETS

When the cores of foundry molds are not supported or held securely by suitable core-prints, and are likely to be moved from their proper position by the wash and lifting action of the molten metal, it becomes necessary to secure or anchor them with chaplets. These are made in a variety of shapes and sizes to meet the different conditions that may arise.

MOTOR CLASSIFICATION

Motors may, for convenience, be classified with reference to their speed characteristics as follows: (1) Constant-speed motors, the speed of which is either constant or does not vary materially; such as synchronous motors, induction motors with small slip, and ordinary direct-current shunt motors. (2) Multi-speed motors (two-speed, three-speed, etc.) which can be operated at any one of several distinct speeds, these speeds being practically independent of the load, such as motors with two armature windings, or induction motors in which the number of poles is changed by external means. (3) Adjustable-speed motors, in which the speed can be varied gradually over a considerable range, but when once adjusted remains practically unaffected by the load, such as shunt motors designed for a considerable range of speed variation. (4) Varying-speed motors, or motors in which the speed varies with the load, ordinarily decreasing when the load increases, such as series motors, compound-wound motors, and series-shunt motors. As a sub-class of varying-speed motors may be cited adjustable varying-speed motors, or motors in which the speed can be varied over a considerable range at any given load, but, when once adjusted, varies with the load, such as compound-wound motors arranged for adjustment of speed by varying the strength of the shunt field.

JUTE

Jute is a fiber obtained from the inner bark of certain trees growing in India, and is used to some extent as an electrical insulating material. For this purpose, it is usually softened and made less brittle by impregnating it with paraffin or some similar mineral oil. It is used extensively as a filler in lead-covered cables. The puncturing voltage for impregnated jute, for a thickness of about 1/8 inch, is about 5000 volts; for a thickness of 1/4 inch, about 7500 volts; for a thickness of 1/2 inch, 12,000 volts; and for a thickness of 1 inch, 20,000 volts. When used as a filler between the insulated conductors of multiple-conductor cables, jute is placed directly in contact with the insulation. Tarred or asphalted jute is also used as a filler between the sheath and armor of armored cables.

INDUCTION

Induction, in electricity, is the phenomenon by which a body charged with electricity or magnetism, or conducting an electric current, produces an electric or magnetic condition in a neighboring body without direct contact. "Electrostatic induction" is the production of an electrical charge in a body by the influence of another body which is charged with static electricity. "Electrodynamic induction" is the production of an electromotive force in another circuit by the influence of an electric current. When the current is induced by the action of a magnet, or when a magnetic condition is induced by an electric current, the phenomenon is known as "electromagnetic induction." "Magnetic induction" is the production of magnetic properties in a magnetic substance by another magnet.

VALVES OF BALANCED AND AUTOMATIC TYPES

In order to assist in the operation of valves that are under heavy pressure, provision is made in certain types of valves called "balanced valves," to equalize the pressure on each side of the valve and thus make the operation easier. Automatic valves also are designed to work on a similar principle, the valve being operated by any change in pressure of the liquid or gas passing through it. A valve of the automatic type is often used for automatically closing a pipe line when an abnormal flow of steam occurs at any portion of the line. Valves of this kind may be placed between each boiler in a battery and the steam header. In the event that a steam main should burst or a cylinder head fly off, or if an injury should occur to the steam line beyond the valve, all the valves of the different boilers in the battery would close immediately and prevent the steam from escaping into the building and doing further damage. In the case of an accident to a single boiler in a battery, such as a burst tube, the valve on that particular boiler would instantly close and prevent all the other boilers connected to the header from emptying their steam through the opening in the injured boiler.

SILICON BRONZE

Silicon bronze is an alloy made from varying proportions of copper and silicon, often containing small percentages of zinc and tin. This alloy has been used to a considerable extent for wires conducting an electric current, such as trolley, telephone, and telegraph wires. It is made by heating fluosilicate of potash, granulated glass, chloride of sodium and calcium, and carbonate of soda and lime in a plumbago crucible. This mixture, after reaction takes place, is added to molten bronze. Silicon-bronze wire has a high electric conductivity, amounting to from 40 to 98 per cent of that of copper wire, or four times greater than that of iron. Its tensile strength is also high, varying from 55,000 to 110,000 pounds per square inch. The electrical conductivity decreases as the tensile strength increases, so that wire having a conductivity of 95 per cent of that of pure copper has a tensile strength of 55,000 pounds per square inch, while wire having a conductivity of 40 per cent of that of pure copper has a strength of about 100,000 pounds per square inch. The wire resists oxidation to a considerable extent, and has been largely used for telegraph wires. Ordinary drawn and annealed copper wire has a strength of only from 30,000 to 40,000 pounds per square inch.

FLAT ROPE

The type of wire rope that is made in the form of a band or ribbon and that has been likened to a watch spring, because it will wind upon itself in a very narrow space, is known as "flat rope." It is composed of a number of wire ropes known as "flat-rope strands" placed side by side and then sewed together with soft iron wire. The sewing or filling wires are of a much softer material than the steel wires composing the strands of the rope, and, therefore, act as cushions for the strands. Flat ropes are used principally for hoisting purposes. When round ropes are used for hoisting heavy loads from deep shafts, very large and heavy drums are required on which to wind the rope, but the flat rope, winding on itself, needs a reel only a little wider than the rope itself. In addition, the flat rope has the advantage that it does not spin or rotate the load in the shaft. Such ropes are made in sizes ranging from 1 3/4 to 8 inches in width, from 1/4 to 7/8 inch in thickness, and up to 3000 feet in length.

Design of Lathe Centers

Typical Designs for Different Classes of Work—Second of Two Articles

By FRED HORNER

BALL-BEARING centers have recently gained considerable favor, especially in the field of rapid-production lathes equipped with multiple tools. In these designs, the shank of the center is very long and the bearings are spaced well apart, so that ample stability is provided. A commercially manufactured center applicable to any lathe is illustrated in Fig. 8. This center is of simple construction, with two journal bearings, and one thrust bearing, held in place by a threaded disk at the front end.

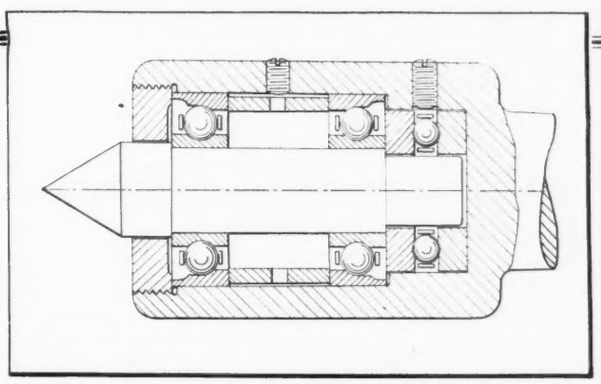


Fig. 8. Commercial Type of Ball-bearing Center

Many of the pieces machined on multiple-tool lathes cannot be run on point centers, but must be held on arbors provided with rapid clamping devices instead of the usual clamping nut. The advantage of ball-bearing construction in such cases is considerable. In Figs. 9 and 10 are shown set-ups used on the Fay lathe. The ball-bearing center shown in Fig. 9 has a hollow end which is supported by the work-arbor. The shoulder on the center is in contact with the face of the hub on the work and serves to press it upon the arbor. The center shown in Fig. 10 has special provision for preventing distortion of the work in case the bosses are not faced square. Collar *A* touches the work in two places only, and swivels around pins *B*, being retained by a spring. Spacers *C* and *D* are also loose on the arbor, and have two-point contacts.

The details of a spigot center chuck arrangement which supports the work at both ends are shown in Fig. 11. This design requires no arbor and enables the work to be set up quickly. In Fig. 13 is shown a set-up in which the arbor has two hardened locating collars, three expanding pins for driving, and a spring-actuated push-off pin which strips the work from the arbor when the back center is withdrawn.

Heavy-duty centers are sometimes made with two roller races and a ball race for the thrust. A relatively simple design, as compared with some of the types previously described, is shown in the lower view of Fig. 12. This center is designed for use on long work which needs support while being machined on a turret lathe. In the upper view of Fig. 12 is shown a hollow center provided with a ball thrust bearing. At *A*, Fig. 15, is shown a ball-bearing pipe center. In this design, the center is forced over the race, protecting the bearing from chips and grit.

Self-oiling Centers—Spring Tension Centers

Many self-oiling centers have been invented, but very few are actually in use. Some types convey the oil down a slot to the point, others through a hole in the center, but there is always the risk of grit finding its way in with the oil. One method, shown at *B*, Fig. 15, utilizes a Stauffer lubricator, in which the grease is sealed to exclude dirt. With this type, the grease is forced down the hole by giving the cap a partial turn at frequent intervals.

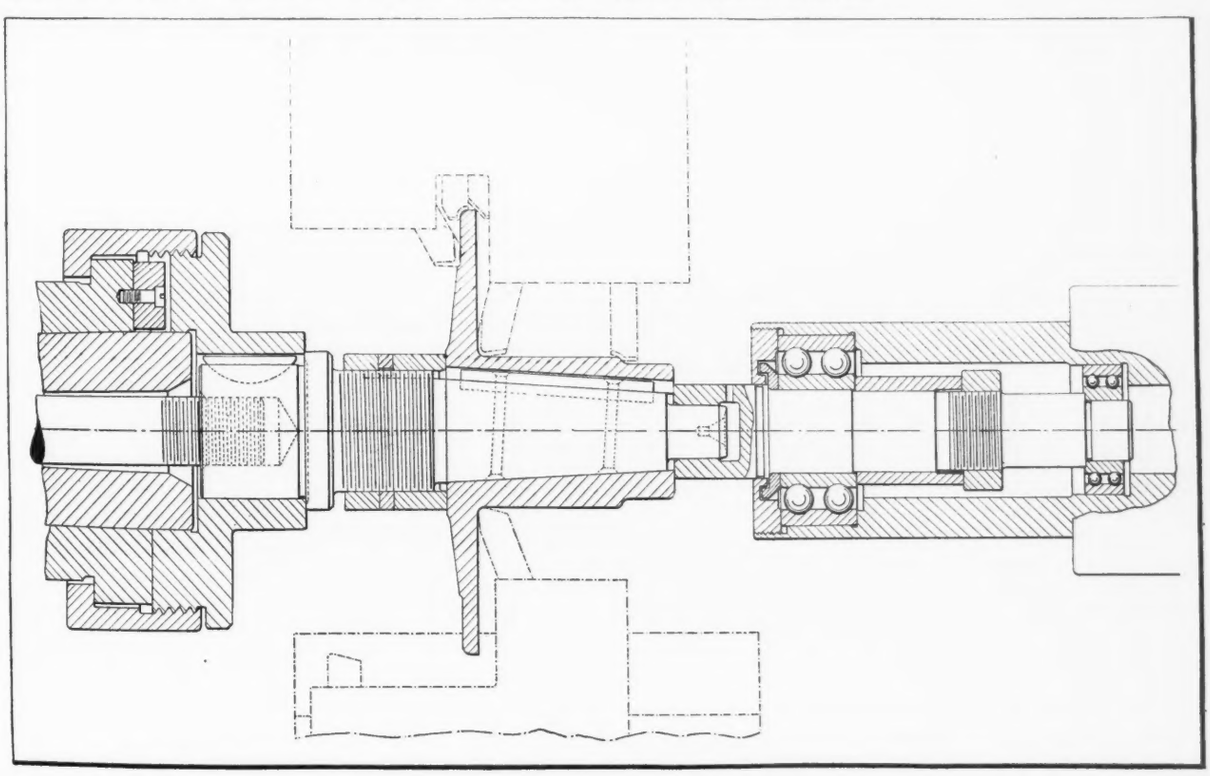


Fig. 9. Ball-bearing Hollow Center used on a Multiple-tool Lathe

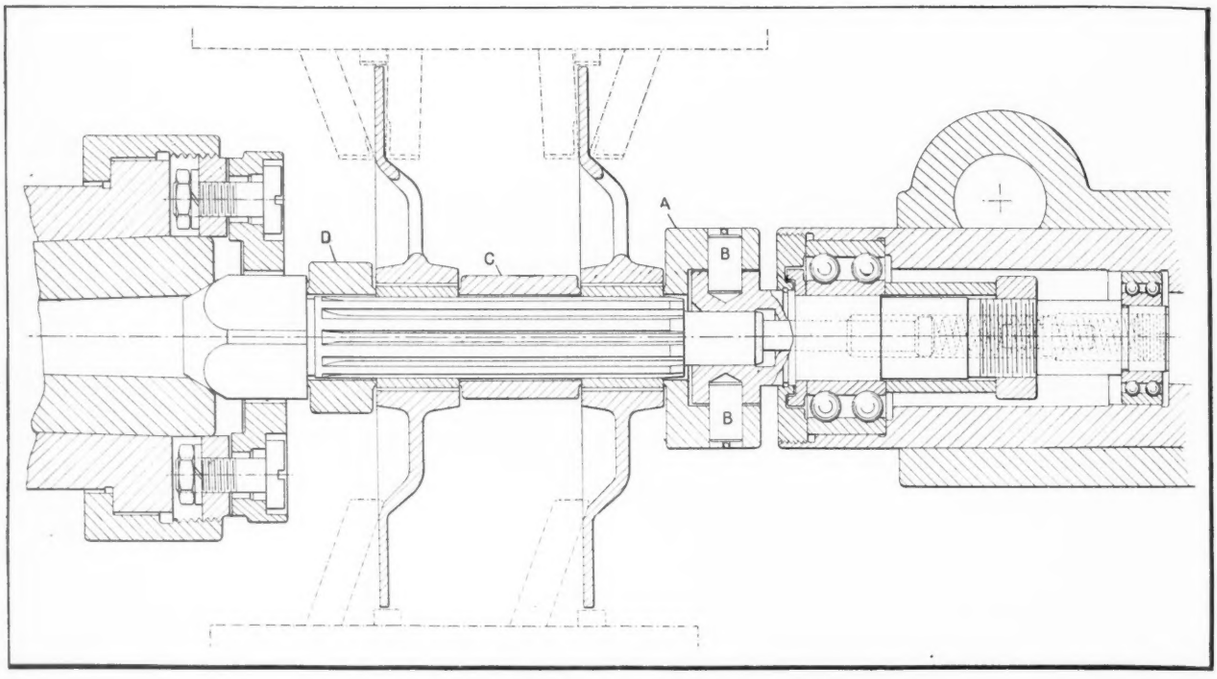


Fig. 10. Centered End Arbor with Locating Clamping Collars

Centers of the spring tension type have two principal applications, namely for quick chucking purposes and for setting or pressing the work against a locating shoulder. For quick-changing requirements, the center has a sleeve which can be pushed back to permit insertion of the work, so that no adjustment of the footstock spindle need be made. The other application—that of setting a piece up to a shoulder—has a center that recedes until the location of the work is accomplished.

A center of the latter type is illustrated at *C*, Fig. 15. This particular center is used on a Fay lathe to hold a stem bevel pinion which must be located accurately by the back shoulder against the hardened collar *E*, for turning and facing the exposed portions. The spring center supports the tail end, and the drive is obtained by means of a dog secured to the shank with a screw. The fixture has an open slot, which permits the work to be put in place and the dog to be clamped.

Another Fay lathe set-up, for a main drive gear, is shown at *D*. In this case, the forging must be located from one end, necessitating the use of a receding center. This construction allows the work to be pushed back into the chuck by advancing the tailstock until the end of the work is in contact with the locating surface.

Quick-acting Centers

At *E*, Fig. 16, is shown a quick-acting center consisting of a holder and cone point. The cone point slides in the holder, and can be withdrawn by pulling the knurled-head screw to a central position. The center is locked in the working position by pushing the knurled-head screw over in either direction in the radial slot.

Centers for Wheel Lathes

At *A*, Fig. 14, is shown a center used in turning wheels for locomotives and rolling stock. The lathes on which this construction is used have the center in each head mounted in a sliding spindle within the main spindle. Endwise adjustment is obtained by handwheels and adjusting screws. The construction permits split bushings to be used in place of centers for holding work on which concentric threads must be cut. The spindles can be used with centers if desired, and retracted into the spindle as required.

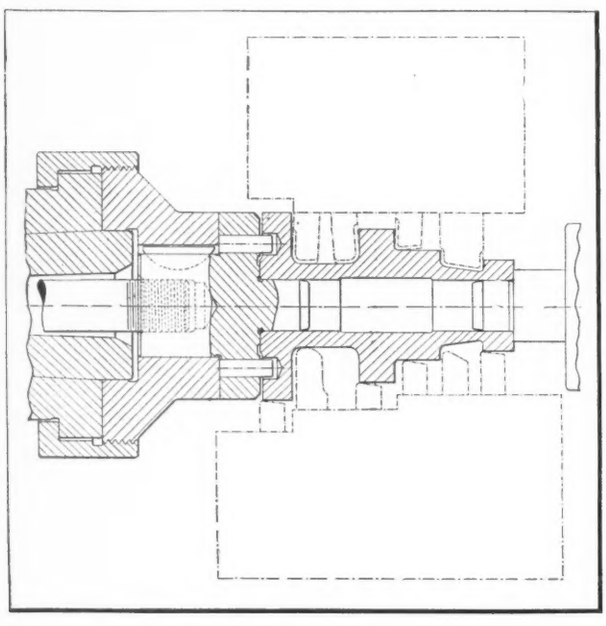


Fig. 11. Center Mounting without Arbor

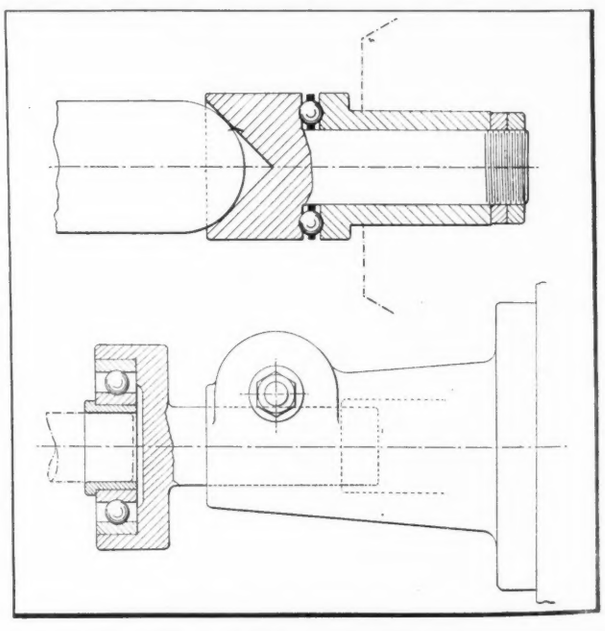


Fig. 12. Hollow Ball-bearing Centers

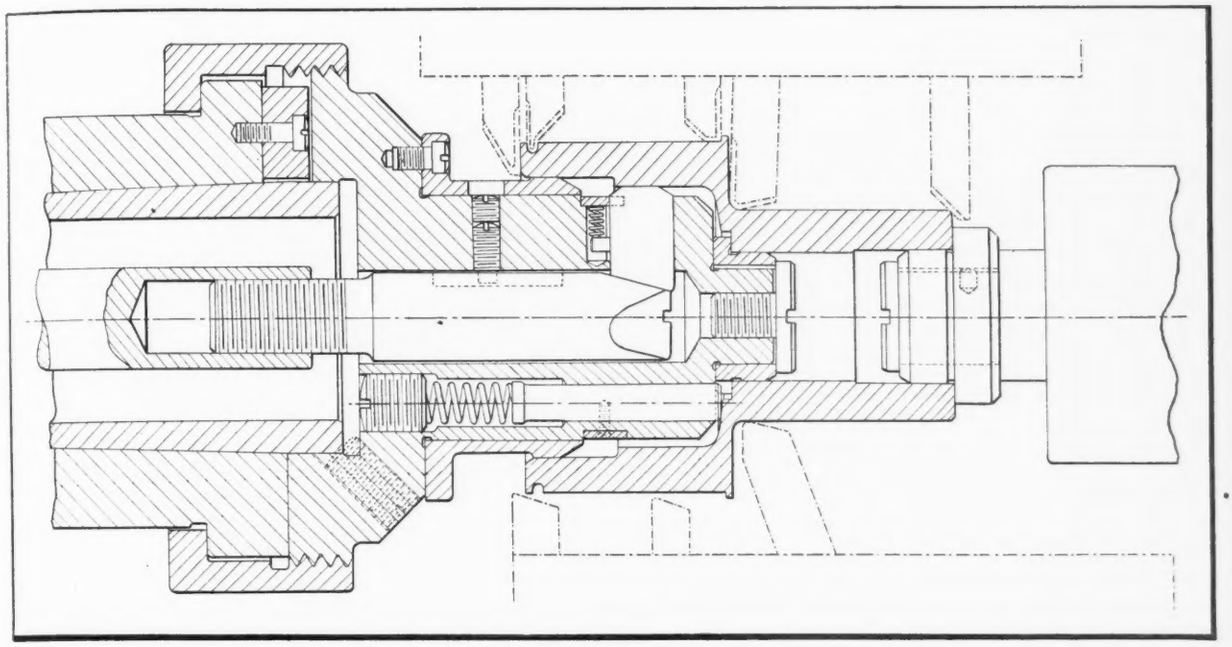


Fig. 13. Locating and Clamping Arbor with Ball-bearing Center

When the type of wheel and axle to be turned has considerable overhang from the faceplates, the sliding spindles are steadied by split holders bolted to the faceplates. These holders are split and either closed with a binding bolt or a split bushing drawn tight by a nut, as indicated at *B*. The feeding of a center through a live spindle is also practiced occasionally in turret lathe operation, the work or casting being located and partly secured in a faceplate fixture by a center propelled through the spindle.

Dead Centers

When highly accurate turning or screw-cutting is required, it is best to run the work on a stationary center at the head end, so that no error can arise from inaccuracies in the spindle, the bearings, or the center. Two similar dead-center heads on a bed, with a hand-rest, is all that is required for certain kinds of work. On bench lathes, a pulley revolves around a bushing on the spindle nose, and drives the work dog in a manner similar to that used on grinding machines.

On a few special lathes, the dead-center principle is used for all operations, while some lathes are so designed that either dead or live center turning is possible. At *D*, Fig. 14, is shown an unusual design, made by Herbert Hunt & Sons, of Manchester, England, which is included in their complete equipment for producing twist drills. This is a simple, single-purpose lathe, on which the taper shanks are turned on the drill blanks with a forming attachment. To maintain the correct relationship between the end of the blank, the tool, and the forming attachment, the adjustable center is fixed in the headstock, while the tailstock center remains immovable.

Driving is accomplished by a three-step pulley on the shaft at the back, with an end pinion meshing with the combined spur gear and driver-plate that revolves around the fixed spindle bushing. On the other end of the rear shaft is a small three-step cone (not shown) for obtaining the feed drive. The spindle *E* is splined to the front end of the fixed bushing *F*, and can be adjusted endwise by turning the

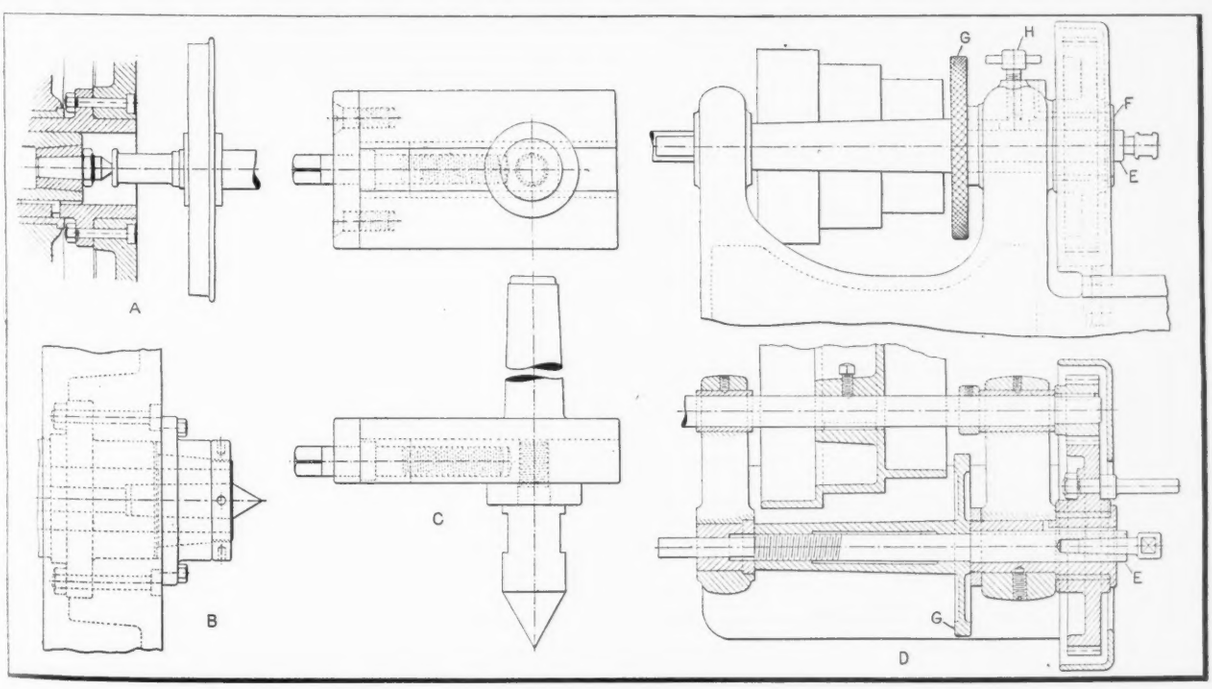


Fig. 14. (A) Wheel Lathe made with Adjustable Center; (B) Center with Supporting Bushing on Faceplate; (C) Offset Center for Taper Turning; (D) Dead-center Head with Adjustable Spindle

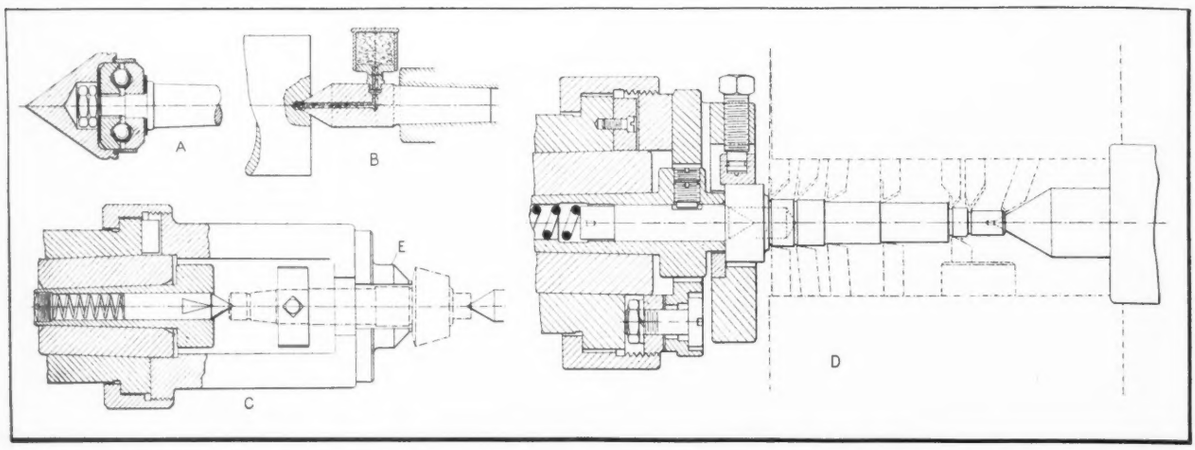


Fig. 15. (A) Ball-bearing Pipe Center; (B) Center equipped with Grease Cup; (C) Spring Center which permits locating Work from Rear Shoulder; (D) Spring Center designed to allow End Location

knurled disk *G*, thus feeding spindle *E* back or forth. Spindle *E* may be locked in place by a pad pressed down by the screw *H*.

Offset Centers

If the tailstock of a lathe cannot be set over for taper turning, this drawback can be remedied by using a center like the one shown at *C*. This center has a slide with screw adjustment by means of which the center can be offset the desired amount. The slide of this holder is milled out to a vee form to hold the slide-piece in which the center is screwed. At the left-hand end of the slide, a short block is forced in, to take the thrust of the screw collar, while the thrust in the other direction is taken by the retaining plate. Graduations (not shown) indicate the degree of set-over, and when the center is tightened by a wrench, it draws the slide-piece up tight and presses the circular washer against the face of the slide, thus making the whole assembly rigid.

Vee Centers for Drilling Purposes

Several kinds of work-supports are available for use in the tailstock when drilling cross-holes in shafts. A small faceplate, with or without clamping facilities for the work, and different vee centers, such as the solid one shown at *F*, Fig. 16, are commonly used. At *G* is shown a revolving vee-shaped support which is useful in handling awkward work. At *H* is shown a large vee-shaped support. The offset vee at *I* enables holes to be drilled close to a shoulder. The center *J* may be used as a pad or a vee, as desired. The employment of one shank, with interchangeable vee-heads may be mentioned, though it is hardly a time-saving practice unless the heads fit loosely on the end of the holder.

Cutting Centers

The old-time method of centering a rough shaft was to run it, after it had been centered approximately true, upon a square center held in the tailstock spindle. The work was pressed over with a crotch bar held on the slide-rest until a square center, such as shown at *A*, Fig. 16, produced a true center in the work. Such crude methods have practically disappeared with the development of proper centering methods and accurate centering drills. The fluting of the centering tool, as shown at *B* or *C*, gives it better cutting qualities

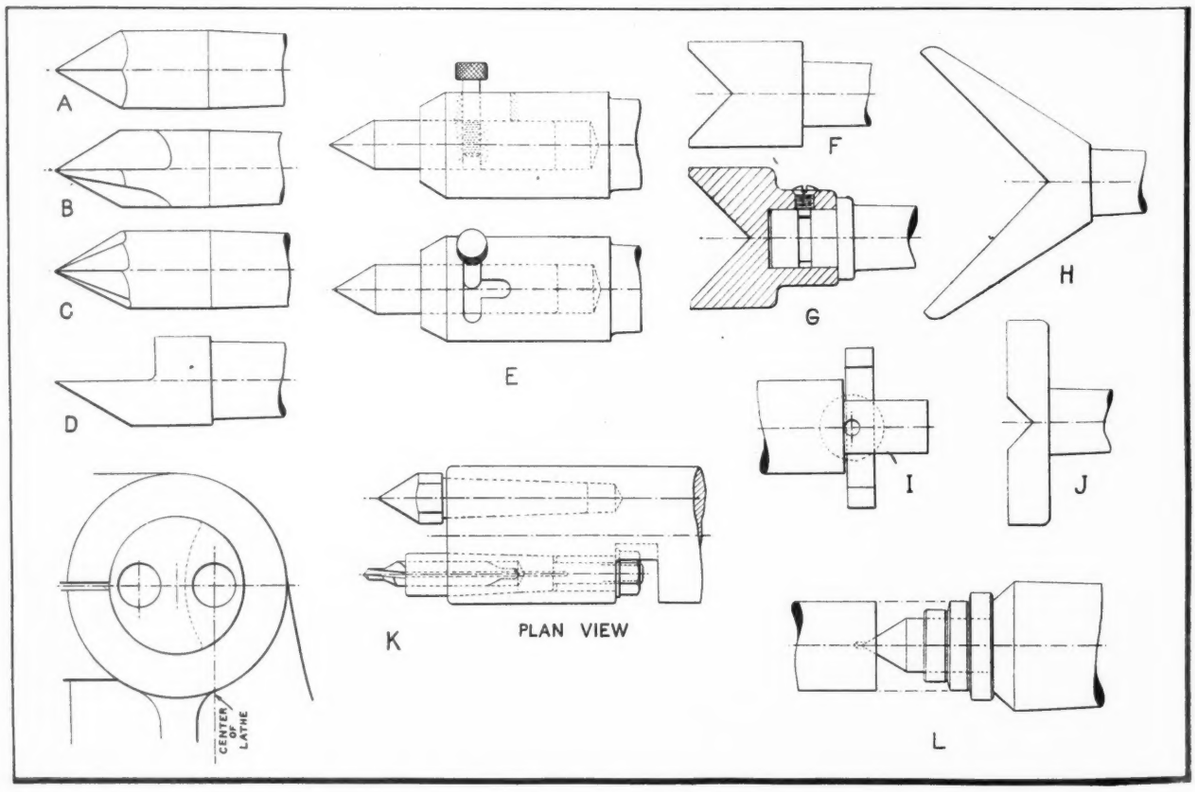


Fig. 16. (A), (B), (C), and (D) Square and Fluted Centers; (E) Quick-acting Center for Small Lathe; (F), (G), (H), (I), and (J) Vee Centers used in drilling Cross-holes; (K) Indexing Tailstock Spindle equipped with Center Drill and Work-center; (L) Center provided with Tool-setting Gage

than the tool shown at *A*. At *D* is shown a half-center or center reamer.

Center and Centering Drill in Tailstock Spindle

At *K* is shown a tailstock centering tool employed on the loose head of a lathe made by John Lang & Sons, Ltd., Glasgow, Scotland. It is utilized on a certain class of turret lathe work requiring the ends of bars to be centered and then supported by a center. The holder is first indexed into position for drilling the center, after which it is again indexed to bring the center in line with the work, so as to support it while turning. An index-plate with two notches and a spring locking handle permits the spindle to be locked in the two positions. The indexing mechanism, which is of simple design, is not shown.

Center Attachment for Setting Tool

As a means of setting a tool in approximately the correct position for a roughing cut or a second cut not requiring exact sizing, a setting ring may be slipped over the regular center. The tool nose can be brought up to this ring, using a feeler gage or bit of paper for testing. The tool is thus positioned for turning the work to the same size as the setting ring. The ring is made a good slip fit on the center. Several rings may be used in turning stepped work, or a stepped setting ring may be employed, such as shown at *L*, Fig. 16.

Another kink is to drill a transverse hole through the center and fit a slidable plug in this hole. A hole is drilled at right angles to the first hole and tapped to receive a setscrew. The plug can then be adjusted to the required size and used to set the tool.

Special Centers

It would be possible to illustrate a large number of other centers, employed in wood turning, metal spinning, watch and clock making, etc., but the foregoing deals mainly with machine shop requirements. Many fittings are used in tailstock spindles that cannot be classed as centers, such as those employed for holding chucks, turrets, centering attachments, knurling attachments, drilling attachments, die-holders, and broaches.

* * *

RIVETING VERSUS WELDING

Frequent references have been made in the technical press to the increasing number of applications of electric welding to structural work. In view of these references, the paper on "Welding in the Structural Field," read by James H. Edwards, assistant chief engineer of the American Bridge Co., New York City, at a recent meeting of the American Bureau of Welding, is of particular interest. The American Bureau of Welding is the research department of the American Welding Society.

Mr. Edwards took exception to some of the statements that have been made in regard to the inroads of welding as a rival of riveting in structural engineering. Quoting Mr. Edwards: "Fabricators from years of experience have learned the virtues and weaknesses of rivets, and know how to use them so as to make economical and safe structures. What they are seeking concerning welding are the fundamental facts on which they may base their determinations of the strength of welded joints. When human life is in jeopardy, one must be cautious. He must know the foundation on which he builds, and be reasonably sure of the results obtained."

According to Mr. Edwards, fundamental information is required on the following points:

1. Can standard structural steel be welded satisfactorily and what are the limitations? If this grade of material is not suitable, what is?
2. What effect will the welding process have on the parent or main material?
3. Standard methods of making welds by different processes should be determined. Values, on some unit basis, for the strength of welds of different types should be fixed. Some reliable way of controlling the mechanical and personal element in the making of welds and in testing the completed work should be established.

Continuing, he said: "With this information fixed by scientific research and available to the industry, the manufacturers of welding equipment, the advocates of welding as a method of joining steel parts, and the fabricators of structural steel, all cooperating to solve an engineering and economic problem, will doubtless make great progress in the development of the art of welding in the structural steel industry."

Mr. Edwards did not take the position that welding is not an important development in the structural field, but the point he raised was that more knowledge is required on the subject. He particularly emphasized the fact that the engineer knows definitely the possibilities and the limitations in regular structural practice with riveted joints, whereas he knows comparatively little about these points in regard to welding, and the details of welding technique require further demonstration.

Research Work in Electric Welding

At the same meeting, research progress in electric arc welding and possibilities of extending research in that field were outlined in a paper by H. M. Hobart, consulting engineer of the General Electric Co., Schenectady, N. Y., and by W. Sparagen, secretary of the American Bureau of Welding. It was pointed out that in the last ten years great progress has been made in arc welding, but that there are even more problems to be solved now than then. Study of the way in which the metal is transferred from the welding wire across the arc to the work was said to be of primary importance. It was suggested that the Bureau of Welding offer prizes for the solution of this, as well as other research questions in this field. The necessity for employing standard tests for determining the quality of welds was also stressed.

On the same subject, a correspondent of MACHINERY recently wrote as follows: "Two items published in March MACHINERY, one on page 529 relating to the welding of structural members of a two-story building in Canton, Ohio, and one, the article on page 550, "The Broadening Field of Arc Welding," prompt the writer to refer to the status of welding as compared with riveting in the general engineering field. The two items published might leave the impression in the reader's mind that riveting is in danger of being entirely supplanted by welding. It would be unfortunate if such an impression were left, because as far as the writer can see, for many years to come riveting will remain the more important method, when the entire field of riveting and welding is surveyed.

"There is a broad field for both riveting and welding, as anyone will discern who analyzes the subject in a fair and impartial manner. It is not the writer's intention to minimize the importance of the new welding methods, but rather to emphasize some of the present limitations of these methods, and to point out that there are still fields where riveting remains the more important process.

"Those interested in the commercial application of welding methods will appreciate free and open discussion of the subject, because nothing could be more harmful to the introduction of a new method than an over-statement of its value and its applications. This would lead to its use for purposes for which it may not be suited in its present state of development, and this, in turn, might lead to failures, which would give the new process, as a whole, a bad name, even for applications for which it is wholly satisfactory. Whether the welding of structural steel members holds advantages over the riveted structure can only be determined by undertaking its fabrication on an everyday commercial basis. Claims of lower costs and superiority of product must be demonstrated by actual performance in work in which welding is used for joining plates, shapes, bars, etc., of the type constituting the nation's tonnage."

Wear of Gear Teeth*

By EARLE BUCKINGHAM, Professor of Engineering Standards, Massachusetts Institute of Technology, Cambridge, Mass.

ONE of the first problems that required a solution in the proper design of gears was that of the strength of the gear teeth. Today, the Lewis formula is extensively employed for this purpose. This formula establishes safe working loads that will not break the teeth of the gears. Now we are faced with an additional problem that requires a similar solution. The requirements for gears have become more and more severe. We are seldom troubled with the breaking of gear teeth, but often find that the gears are wearing too rapidly. Although we have thousands of installations in service, the several factors involved are so different that we are unable to draw any useful conclusions from such data until we can establish some common basis of comparison. In other words, we need a "yard-stick" in order to make useful comparisons on the wear of gears. The purpose of this article is to suggest a form for such a "yard-stick" that will assist us in the absence of more exact knowledge.

The results of several interesting experiments on the wear of gear teeth have recently been published. Most of these investigations deal primarily with the rate of wear on the tooth profiles when sufficiently high pressures are imposed upon the teeth to produce wear in a comparatively short time, sometimes in a few hours.

Maximum Loads that do not Produce too Rapid Wear

The producers of gears, however, are not so much interested in how fast a gear tooth wears, nor to what shape it wears, as in knowing the maximum loads he can impose upon the gear teeth without obtaining any appreciable wear. In this respect, gear tooth wear is very similar to the wear of plain bearings. The rate of wear of bearings is a secondary matter. The essential thing is to establish reliable pressure and velocity relationships, so that wear does not take place to any appreciable extent. When wear once starts, the further useful life of a bearing is very short. The same is true of gears. We should search, therefore, for some method of determining the pressure and velocity relationships of gear teeth which will establish loads that will not result in excessive wear. In many cases, wear on gear teeth first becomes apparent at or near the pitch line. Why this is so is still somewhat of a mystery. Possibly one contributing cause is the fact that at this point, one tooth is usually carrying the entire load, while at the top and bottom of the active profile, two teeth are in engagement.

Investigations of Gear Drives for Durability

Investigations covering a large number of gear drives showed results that were far from uniform. This was to be expected, because all gear drives are not loaded to their extreme capacity. One pertinent fact, however, seems to stand out. When the stresses were below the elastic limit of the material, the wear of most of the gears was not appreciable. When these stresses exceeded the elastic limit, sometimes the gears stood up, but some of them showed signs of rapid wear. Therefore, the elastic limit of the material seems to be a good stopping point in determining safe loads for wear.

It might seem as though the rate of wear should be proportional to the pressures, all other factors being equal. This does not prove true in practice, however. There seems to be a critical point, below which the wear is negligible and above which wear is rapid. Professor Ham remarks on this point, "Surface pressure is the most important of the factors which affect durability. Apparently, for any pair of gears, there is a critical surface pressure, governed by the properties of the materials, above which the life of gears is short and below which the gears will run indefinitely without appreciable wear."

Formula and Constants for Determining Maximum Safe Load

As a result of comparisons of different gear drives, the writer worked up a set of constants for use in establishing the maximum safe load for wear of gears of different materials. In general, these are based on maximum specific stresses of about 75 per cent of the elastic limit of the weaker material. The data on cast steel was very erratic, and no attempt was made to include any of the alloy cast steels, as but little information was available about the physical characteristics of these materials.

In extreme cases, the writer has used values 50 per cent greater than the tabulated ones. He has data on successful drives which employ values that are double the tabulated ones, but these are exceptions, such as airplane drives, etc., where one is justified in taking chances on rapid wear to secure lighter weights, and extreme care is taken in the production and mounting of the gears.

TABLE 1. RATIO FACTORS USED IN FORMULA

Ratio of Gear to Pinion	Ratio Factor Q	Ratio of Gear to Pinion	Ratio Factor Q
1 to 1	1.000	8 to 1	1.778
2 to 1	1.333	9 to 1	1.800
3 to 1	1.500	10 to 1	1.818
4 to 1	1.600	12 to 1	1.846
5 to 1	1.667	15 to 1	1.875
6 to 1	1.714	Rack	2.000
7 to 1	1.750	.....	.....

Machinery

In order to simplify the equation still further, a pressure angle of 14 1/2 degrees was assumed as a constant angle. This reduces the loads slightly as the pressure angles increase, but as the normal tooth pressures increase very slightly with higher pressure angles, the resulting difference is slight and on the side of safety.

The formula for wear, which can be used for checking tooth design for wear, is as follows:

$$W = D \times F \times K \times Q$$

in which

W = safe load on teeth for wear, in pounds;
D = pitch diameter of pinion, in inches;
F = width of face of gears, in inches;
K = wear load factor;
Q = ratio factor, which is equal to $\frac{2N}{N+n}$, when n = number of teeth in pinion, and N = number of teeth in gear.

The accompanying tables give the values of K and Q, the wear load factor and the ratio factor, to be used in the formula for different conditions. The values given in the table for K are for gears with smooth tooth surfaces, suitably lubricated and carrying uniform loads. The critical pressures beyond which rapid wear occurs are from 50 to 100 per cent greater than those obtained by using the values given in the table.

Experience indicates that the action of a smooth hardened tooth meshing with one of softer material burnishes and hardens the surface of the softer material, thus enabling it to carry heavier loads without wear. The smoothness of sur-

*Abstract of paper presented before the tenth annual convention of the American Gear Manufacturers' Association at the Book-Cadillac Hotel, Detroit, Mich., May 13 to 15.

face plays a very important part in minimizing wear. The bronze referred to in the tables should be of a high quality. The requirements of spur gears and worm-gears are quite different, so that the bronze that proves best for worm-wheels is not necessarily the best for spur gears. The values are based on uniform load conditions. Intermittent and shock loads must be handled individually. With such loads, the attempt should be made to determine an equivalent steady load and figure accordingly.

One other factor should be mentioned, and that is the relation between the diameter and the face of the gear. Sometimes a face of not greater than twice the diameter of the pinion is specified as the maximum face. In general, it would be better to reduce this face to not more than 1 1/2 times the diameter of the pinion. With long faces, the torsional deflection of the pinion causes the load to be concentrated on one end, resulting in local wear.

Example of Use of Formula and Tables

We will illustrate the use of these tables by a definite example. Take a pair of two diametral pitch gears, 20 and 60 teeth, with a 6-inch face, running at a pitch line velocity (V) of 380 feet per minute, and calculate from the foregoing tables their safe load for wear. The pinion is made of hardened steel and the gear is made of heat-treated steel. Thus we have: $D = 10$ inches; $F = 6$ inches; ratio $= 3$ to 1, whence $Q = 1.5$; K (from table) $= 104$. Then

$W = D \times F \times K \times Q = 10 \times 6 \times 104 \times 1.5 = 9360$ pounds.

$$\text{H. P.} = \frac{W \times V}{33{,}000} = 108 \text{ horsepower}$$

As a matter of fact, these gears are in successful operation delivering a maximum horsepower of 175, or about 62 per cent more than that obtained from the tables. These gears are used where minimum space is essential, and also where the full power is not constantly applied. As stated before, the tabulated values are safe values for general use, and would be exceeded in extreme cases. In general, 50 per cent greater than the tabulated values is a good place to stop, as this seems to bring the pressures very close to the critical one where rapid wear starts.

It is interesting to note the high wear value of cast iron. This has proved itself in practice many times, when a cast-iron gear has stood up where a forged steel gear soon showed signs of abrasion. For a balanced design for both tooth strength and wear, much coarser pitches should be used for cast-iron gears than for steel gears.

The writer does not pretend that this information is the last word on the subject. It is offered for use in making comparisons of different gear drives, and for general use for gear design in the absence of anything better.

* * *

FACTOR OF SAFETY OF WOOD

The belief that a timber with a so-called "factor of safety" of 3 or 4 will carry three or four times the load for which it is designed is erroneous and has been the cause of failures through the overloading of structures. Only a small part of the usual "factor of safety" for wood is available for taking care of overloading; most of it is required to allow for the known variability in the strength of clear wood, the effect of defects, the moisture conditions of service, and the duration of the load.

Some of the working stresses assigned by the Forest Products Laboratory, Madison, Wis., to structural timbers, when compared with laboratory test data on small, clear specimens, have an apparent "factor of safety" as high as 10, but in reality such factors make allowance for an accidental overload of only 50 per cent.

The "factor of safety" for timber is not designed to take care of large overloads. In good construction, occasional timbers might be expected to fail immediately if they were subjected to only twice their design loads. Forty per cent of the timbers would probably fail if such loads were applied for a long time.

TABLE 2. VALUES OF K USED IN FORMULA

Material in		Pitch Line Velocity, in Feet per Minute								
Pinion	Gear	0	200	400	600	800	1000	1500	2000	2500
Cast steel	Cast steel	25	19	17	16	15	14	13	12	..
Forged steel	Cast steel	30	23	21	19	18	17	16	15	14
Forged steel	Forged steel	40	30	28	26	25	24	22	20	19
Hardened steel	Cast steel	50	38	35	32	31	29	27	25	24
Forged steel	Semi-steel	60	46	42	39	37	35	32	30	28
Hardened steel	Bronze	70	53	49	45	43	41	38	35	33
Hardened steel	Semi-steel	80	61	55	52	49	47	43	40	38
Semi-steel	Semi-steel	100	76	69	65	62	59	54	50	47
Ht. tr. steel	Ht. tr. steel	100	76	69	65	62	59	54	50	47
Hardened steel	Ht. tr. steel	150	114	104	97	92	88	81	75	71
Hardened steel	Hardened steel	250	190	173	162	154	147	135	126	119

Material in		Pitch Line Velocity, in Feet per Minute								
Pinion	Gear	3000	3500	4000	5000	6000	7000	8000	9000	10,000
Hardened steel	Cast steel	23	22	21	..	..	..	..	..	..
Hardened steel	Bronze	32	30	29	27	26	25	..	..	..
Hardened steel	Semi-steel	36	34	33	31	..	..	..	..	..
Ht. tr. steel	Ht. tr. steel	45	43	42	39	37	35	33	32	31
Hardened steel	Ht. tr. steel	68	65	63	59	55	53	50	48	47
Hardened steel	Hardened steel	113	108	104	98	92	88	84	81	79

Machinery

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MANAGEMENT ASSOCIATION MEETINGS

The financial executives' division of the American Management Association held its second conference at the Hotel Astor, New York City, May 26 and 27. Among the topics discussed were budgeting practices, financial operating ratios, and the financing of pension plans.

The production executives' division of the association will meet at Silver Bay, Lake George, N. Y., June 30 to July 2. Among the subjects that will be discussed at this conference are "The Supervisory Forces—Their Selection, Development and Compensation;" "The Foreman as Manager;" "The Relation of the Foreman to Staff Departments and to Functions Such as Inspection, Costs, Planning, Maintenance, Engineering, and Supply;" and "The Relation of the Foreman to Personnel Problems and to His Men." Other papers will deal with "The Rating of Supervisors;" "Supervisors, Their Qualification and Selection;" "Women in Supervisory Positions;" "Foreman Training;" and "Foremen's Clubs."

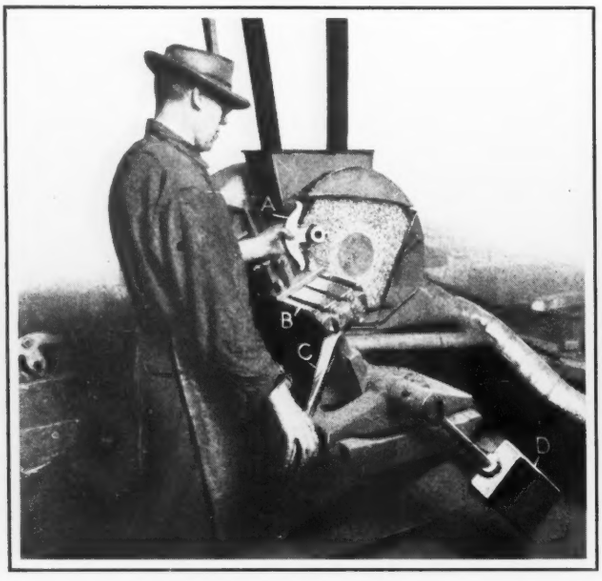


Fig. 1. Facing Bosses on Small Castings

Fig. 2. Disk Grinder with Planer Type Table

Disk-Grinding on Production Work

By W. F. SANDMANN

IN its early form, the disk grinder was exceedingly simple, consisting in the main of a pedestal fitted with a spindle running in large bearings. To each end of the spindle was attached a flat steel disk wheel, the outer sides of which were faced with a fine emery cloth. A rocker-shaft projected out on each side of the pedestal below the spindle and supported plain work-tables. This type of machine proved very effective on light finishing and polishing operations thirty years ago, and the design continued practically the same for a long period of years.

The last few years, however, have brought about the entire redesigning of the disk grinder. Many of the present grinders are automatic. New types of work-tables and supports have made it possible to take heavy cuts directly on rough castings, forgings, and bar stock. Suitable holding fixtures play an important part in disk-grinding, and careful consideration is now given to this equipment.

In Fig. 1 is shown a disk grinder built by the Badger Tool Co., Beloit, Wis., in operation, facing a boss on a small casting. The casting *A* is held in a quick-acting fixture which is mounted on the table *B*. After clamping the casting in the fixture, the operator merely pulls on the lever *C*, to bring the work-table and casting up to the wheel. He then rocks the table across half the wheel by means of the same lever. The counterweight *D* balances the table so that it can be easily rocked. It will be noted that, instead of the table being supported simply on a bar, it swivels on a saddle which is solidly supported by the base casting so that vibration is eliminated. The production on this operation was 180 pieces per hour.

In Fig. 2 is shown a disk grinder equipped with a table similar to that used on a planer, except that it is manually operated. This illustration shows the machine in operation surfacing back gages for paper cutters that are of a very frail design. The light webs, the edges of which are ground, would be distorted easily under pressure. However, the grinding wheel passes rapidly over them, so that neither heating nor distortion takes place. The wheel shown is of the cylinder type.

Double-end Disk Grinder

Fig. 3 shows a double-end disk grinder with a different type of table at each end. The operator shown in the foreground is using the standard lever-feed table previously described, and is grinding the end faces of manifold castings. It will be noted that the wheel is of the cylinder chuck type. The faces *A* of the castings were previously ground on the planer type table at the opposite end of the machine, where

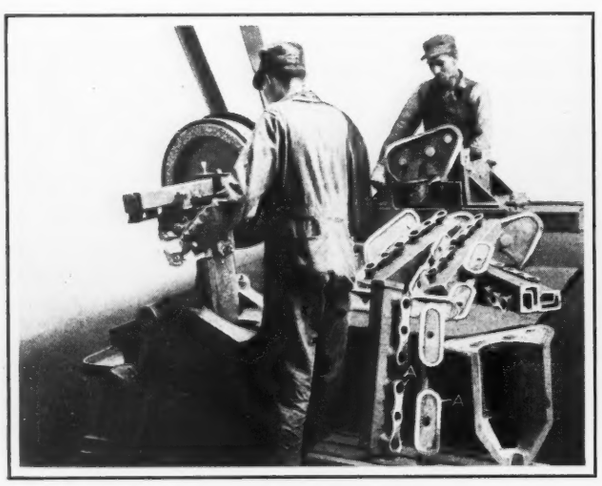


Fig. 3. Double-end Type of Disk Grinder

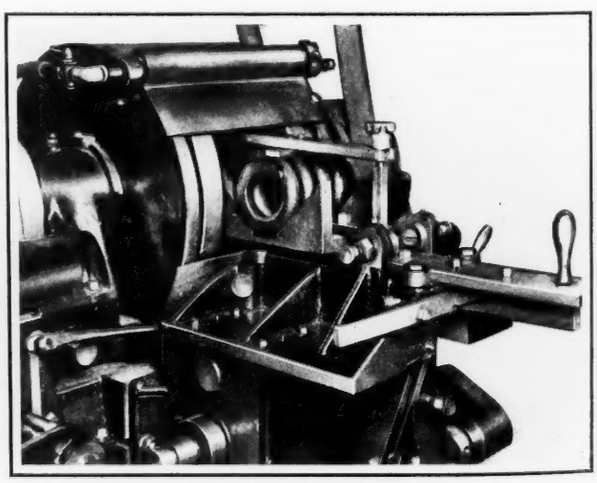


Fig. 4. Automatic Double-end Grinder

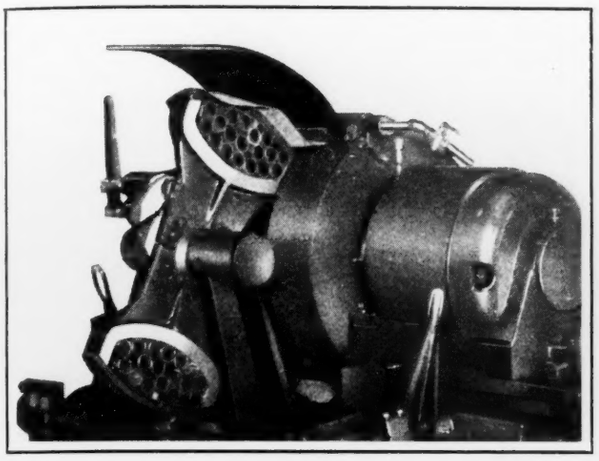


Fig. 5. Double-end Holder used in grinding Ends of Small Springs

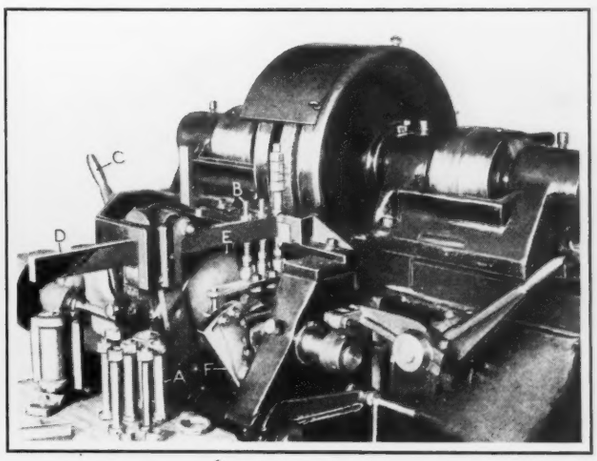


Fig. 6. Grinder equipped for grinding Nut Faces

the operator is shown removing a gear-case cover from the fixture, the three bosses and joint face having been ground. Because of the inexpensive fixtures and the rapidity with which fixtures can be changed, a double-end machine of this type can handle a great quantity of various classes of face grinding work.

Automatic Grinder

The automatic double-end grinder is one of the latest types of disk grinding machines. Two wheels are used in this grinder, so that both sides of a piece can be ground at the same time. The wheels both rotate toward the operator. A machine of this type is shown in Fig. 4 equipped for grinding the ends of large car coil springs. The springs are clamped in a V-block, and one pass between the grinding wheels faces both ends and finishes the springs to their free length.

The grinding of the ends of small coil springs such as are commonly used in automobile starters presents a problem that is somewhat different from that encountered in grinding large springs. A double-end holder is used for this work, as shown in Fig. 5. In this case eighteen to twenty springs clamped in one end of the holder are ground while the operator is unloading and reloading the opposite end of the holder. It is not necessary that the faces of the springs be all in the same vertical plane, as they go between the grinding wheels when the fixture is brought into the grinding position before the wheels come in contact with the work. The wheels then feed in and push the springs into line as they begin grinding. The holder reciprocates slightly, so that the wheels wear evenly.

In Fig. 6 is shown a machine equipped for grinding the faces of nuts. The operator loads the rough nuts on arbors such as shown at *A*, and places three of these arbors on pins *B*. Then the lever *C* is thrown in, and the arbor bar *D* moves in between the wheels which grind the opposite faces of the nuts, after which the bar is pulled out. The latter movement automatically indexes the arbors 120 degrees, and the work is again fed in between the wheels. The third feeding movement completes the six sides of the nuts, after which the bar is backed out and stopped. The feed is obtained with the large cam which can be seen at *E*, and the indexing movement by the mechanism at *F*.

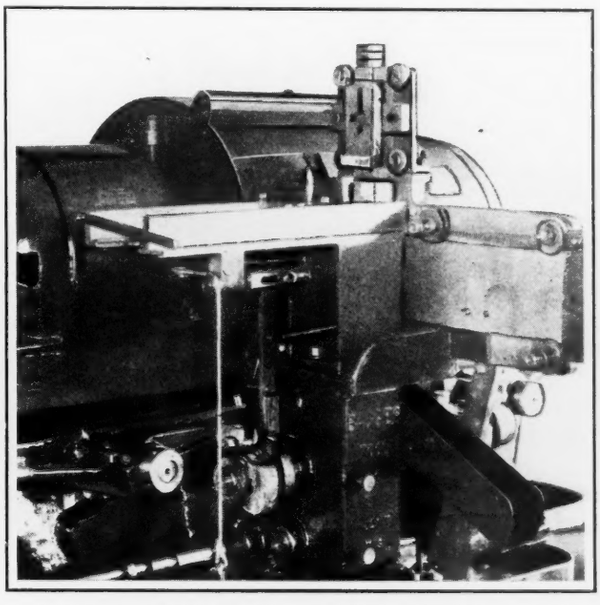


Fig. 7. Grinder equipped with Magazine Feed

An automatic grinder equipped with a magazine feed is shown in Fig. 7. This machine is used for grinding the sides of carbon blocks. The rough blocks are placed in the magazine by the operator, and are automatically fed into the grinding position.

* * *

GIVING THE CUSTOMER WHAT HE WANTS

Many manufacturers have not succeeded because they have insisted on making something for the market in accordance with their own ideas of how it ought to be made rather than in accordance with the ideas of their customers. One automobile manufacturer recently stated that many of the earlier automobile builders failed because they insisted on building a car such as they liked to ride in themselves rather than a car that would sell in sufficient numbers to sustain the business. The same is true of selling and distribution methods. Many of these have failed to function in a satisfactory manner because they have been arranged for the convenience of the manufacturer making the article to be sold rather than for the customer who buys it. The most successful manufacturer and sales manager is he who is able to forget his own opinions and who has the imagination to form a composite opinion of the ideas of the customers to whom he appeals.

* * *

PROPOSED STANDARD LOCOMOTIVE REAMER

The American Railway Tool Foremen's Association, at its convention in Chicago last fall, recommended the adoption of a standard locomotive frame and rod reamer. According to this recommendation, reamers for this purpose should be made in sizes from 1 inch to 2 inches in diameter, by 1/32-inch steps. The taper should be 1/16 inch in 12 inches, and the reamers should be made in the following standard flute lengths: 8, 12, 16, 18, 22, and 26 inches. The flutes are to be left-hand spiral, and the spiral angle, from 12 to 20 degrees.

It was also recommended that these reamers be made in two styles, from high-speed steel, one having four grooves or flutes, and the other having six flutes. The four-groove reamer should be made of the twisted type, and the six-fluted reamer of the milled type.—*Railway Mechanical Engineer*

The Cold-drawing of Bar Steel*

By F. W. KREBS, United Alloy Steel Corporation, Canton, Ohio

IN the following article, the various steps necessary in converting hot-rolled steel into cold-drawn bars are given, together with a general description of the equipment used. The factors that affect the machining qualities of the steel are discussed, and the effects of cold-drawing on the physical properties are referred to. The practice described is that followed by a mill specializing in alloy steels used largely in the automotive industries.

Very little bar stock is cold-rolled today, and although the term "cold-rolled" is still generally used, nearly all the material known as "cold-rolled" is actually cold-drawn. A few manufacturers cold-rolled bars over 4 1/2 or 5 inches in diameter, but the general practice on large-diameter bars, especially shafting, is to turn and polish rather than to cold-roll. One company has built up a high reputation for shafting by turning and grinding the bars. In this manner, finished material of a very high degree of accuracy and straightness can be produced. The largest tonnage of cold-rolled material is in strip stock.

Objects of Cold-finishing

The objects of both cold-drawing and cold-rolling may be one or more of the following: (1) To secure accuracy of size; (2) to obtain a smooth, even surface; (3) to produce thin, complicated sections; or (4) to affect the physical properties.

Cold-drawing causes a permanent distortion of the crystal structure, but there is no refinement of the grain, as this cannot be accomplished with the material below the critical temperature. Cold-drawing accentuates what is known as "banding," and in some instances this effect is so marked that the end of a fractured piece has the appearance of a piped bar. If cold-working has not been excessive, however, the original properties can be restored by annealing.

First Operation Consists of Pickling in Acid

When the bars are brought to the shop for cold-drawing, it is first necessary to remove the scale. This is done by pickling. The solution used is 8 to 10 per cent sulphuric acid of 60 degrees Baumé. The chemical action is increased by introducing steam into the vats. The tubs are built of wood, and are generally about 30 feet long and 4 feet by 3 feet in section. The time of pickling will vary from thirty minutes to two hours, depending upon the character of scale to be removed. Pickling requires care, or else pitting of the finished bars will occur. Sometimes heavy scale will be rolled into a bar in spots. In removing the heavy scale, the remainder of the surface is sometimes over-exposed to the acid.

After pickling, the bars are washed with water to remove the acid. Some shops use boiling water for this. After washing, the steel is transferred to a lime bath. This is a strong solution of water and slaked lime. The basic solution neutralizes the acid which may remain on the bars after washing. The practice in wire plants is to bake rods or wire after pickling. This is done in heated ovens which attain a temperature of 250 to 500 degrees F. The operation is a precaution against brittleness which may be caused by occluded hydrogen picked up from the acid.

Pointing the Bars for the Drawing Machines

The steel is ready for the drawing machines after pickling, except for the pointing. Pointing is necessary to reduce the diameter of the rod or bar so that it can enter the die. This is usually accomplished by turning in a pointing machine. Some shops hot-swaged large sizes, especially heavy flats. A special head equipped with grips is applied to some machines, which forces the end of the bar through the die. Bars 1 1/4 inches and over in size can be easily handled in this way. Most shops do not work smaller sizes in this manner, on account of the trouble due to buckling.

Dies Required for Cold-drawing

The dies are generally made of a special alloy tool steel that is very high in carbon, some analyses running as high as 2 per cent. Dies for rounds are solid; those for squares, hexagons, and flats are made up of sections, as are most dies for special sections. The Brinell hardness will run from 500 to 600, the harder die being desired for the smaller sizes. The life of a die averages about twenty-five coils on alloy-steel-wire sizes. On bars 20 to 30 feet in length, the average life will be about 500 bars.

Drawing the Steel

The drawing machines are horizontal benches, driven by individual motors. The grip or jaws, which take hold of the pointed end of the bar, engage with an endless chain which draws the material through the die. For wire sizes or coils, two types of drum machines are used. On one the axis of the drum is horizontal. This is used for the larger sizes of coiled stock—from about 1/2 inch to 1 inch; it is generally called a "bull block." The drums for drawing smaller sizes —from 3/8 inch down—have the axis of the drum vertical. These are the wire blocks. In wire mills, one operator may have charge of a number of drums, just as in a machine shop, one man may operate several automatic machines.

The draft or reduction per pass varies with the size, analysis, and finish desired. The usual practice is to reduce the diameter 1/16 inch on sizes down to 5/16 inch. Under 5/16 inch, the reduction is generally 1/32 inch. This applies to such steels as screw stock, whether drawn in the hot-rolled, annealed, or heat-treated condition. In some cases, the reduction will be greater than 1/16 inch, and at other times less than 1/32 inch. For instance, if a shop has 13/16-inch steel in stock (which is ordered for 3/4-inch cold-drawn material), it could be drawn to finish 23/32 inch or 25/32 inch. This would be done only for small orders. Again, on very small sizes, since No. 5 B.W.G. rod is about the smallest size most mills can furnish (0.220 inch), it may require two or more drafts or passes to secure the finished size. In such instances, it is generally necessary to anneal and pickle the material between passes, and the draft may be as light as 1/64 inch per pass. A better finish is secured with a heavy draft, and there will be less pitting if the reduction is heavier. This will decrease the drawing speed and hence the production, but the increased cost is warranted for specialties such as piston-pin stock.

The speed of drawing will vary with the diameter and the analysis or condition of the steel, and for various steels will average about as follows:

	Alloy-steel Bars		Carbon-steel Bars	
Diameter, inches	1/2–1 1/2	1 1/2–3 1/2	1/2–1 1/2	1 1/2–3 1/2
Feet per minute	40	30–35	80	60–70

	Alloy-wire Sizes	Screw Stock
Feet per minute	30–100	160

To prolong die life and secure a better surface finish, a heavy grease is used as a lubricant. This is applied to the bar as it passes through the die.

Finishing the Bars

After the material comes from the draw-bench, it must be straightened and cut to length. Straightening is most often

*Abstract of a paper read before the Machine Shop Practice Division of the American Society of Mechanical Engineers at the meeting in Providence, R. I., May 3 to 6.

done in a roll straightener, of which there are several types. In one type, the rolls that do the straightening revolve about the bar as it is fed through the machine. In another, the bar rotates as it moves between the rolls. The principle is that of deflecting the bar, first in one direction and then in the opposite direction, equal distances. The straightening also increases the smoothness of the bar; but if a high polish is desired, the bar will have to be passed through the machine several times. This application of force usually causes the bar to expand. The shop man makes an allowance for the expansion, but it varies with different heats of steel, and sometimes within the same heat; sometimes there will be no expansion. The action is apparently beyond the control of the steel maker. On the average, a change of 0.0005 to 0.001 inch must be allowed for. Very large sizes, above 3 1/2 or 4 inches, may be straightened in a punch. Small coiled stock can be straightened and cut to length in a special machine known as the Shuster straightener. The principle involved is the same as that of the regular roller straightener. In cutting, the bars will be true to 1/8 inch in lengths up to 8 feet for sizes from 1 3/4 to 2 inches, while for smaller sizes they can be held to 1/16 inch.

The standard rejection limits in regard to size for alloy steel are plus and minus 0.002 inch on sizes up to 2 inches. Special tolerances permit only a total variation of 0.0015 or 0.001 inch. It is difficult to do in a steel mill what is intended to be accomplished by a mechanic with a micrometer and a machine tool, but most cold-drawn material runs exceptionally true to size. When special tolerances are to be met, it greatly increases the cost, due to reduced production and increased rejections. If the rejected material cannot be used on other orders, the special order must bear the entire cost.

Factors Affecting Machining Quality

The exacting requirements of steel for automatic machine work have developed many problems for the steel maker. The hot-rolled bars must be of the best grade material. There must be no surface defects which will remain as slivers or seams in the finished bar or product. Chemically, the steel must be uniform, and freedom from injurious non-metallic inclusions is essential.

The machineability is very dependent upon the grain structure and the hardness. A steel can be so soft that it will not cut freely. Certain alloy steels of one hardness, but of an improper structure, will turn the edge of a tool, while if the proper structure is obtained by the correct heat-treatment, it will cut satisfactorily, even though the Brinell hardness is increased. A large, coarse-grained structure in low-carbon and simple alloy steels machines best. Carburizing grades of steel have been quenched in water and then cold-drawn, resulting in improved machineability. Specifications imposing Brinell limits must be drawn very broadly and applied with much discretion, unless the steel is specified to be annealed or heat-treated before cold-drawing.

One of the largest screw machine parts manufacturers has found that cold-drawn alloy steel with a maximum mean carbon range of 0.30 machines best when hot-rolled and cold-drawn and when it has a Brinell hardness of 195-225. This manufacturer's experience has proved that such steels as the S.A.E. Nos. 2315, 2330, 3115, 3130, and 4130 cut better when the Brinell hardness exceeds 225 (ranging from that number to 245) than when it is under 195. Some of the low-carbon complex alloy steels, such as the S.A.E. Nos. 3320, 3312, or 3415, should be annealed before cold-drawing. Alloy steels with a mean carbon of over 0.30 per cent should be annealed before cold-drawing. Not only will the product be more satisfactory for automatic machine work, but metallurgically, or physically, the steel will be much superior. The grain will be finer and more uniform, and the possibility of internal ruptures eliminated.

Effect of Cold-drawing upon Physical Properties

The effect of cold-drawing upon the physical properties of carbon steel is to increase the elastic limit 60 to 100 per cent and the ultimate strength 20 to 40 per cent, and to decrease the elongation and reduction of area.

The effect of cold-drawing upon hot-rolled alloy steel is not so marked, but it causes an appreciable increase in the elastic ratio. The difference is not so great when the bars are heat-treated. Generally, alloy steel heat-treated bars, after cold-drawing, will show an increase of 10 to 25 per cent in elastic limit and ultimate strength, and a decrease in the elongation and reduction of area. The elongation can be increased 2 to 5 per cent by reheating the steel to about 1000 degrees F. At this temperature the steel will not scale, but the bright finish will be destroyed. The hardness is generally increased, the increase being greatest with the small sizes; but it frequently happens that when bars are heat-treated and cold-drawn, the Brinell hardness drops.

* * *

RECLAMATION OF WASTE MATERIALS ON RAILROADS

In a paper read by Robert K. Graham, general superintendent of the Corwith Reclamation Plant of the Santa Fé Railroad, before a meeting of the American Society of Mechanical Engineers held in Chicago, Ill., attention was called to the fact that the reclamation or salvage of scrap was an unrecognized source of profit on every railroad in the United States until about fifteen years ago. It was much easier to discard a worn or broken tool or a dismantled piece of material and to apply to the storekeeper for new tools and materials than to attempt to make repairs or do reclamation work. The Santa Fé is said to be the first railroad to inaugurate regular reclamation work. It first started a yard at Corwith, near Chicago, for the reception and assortment of all scrap materials. This yard is now known as the Corwith Reclamation Plant.

In the ordinary course of assorting all kinds of scrap that came into the yard for classification, it was discovered that a considerable portion of the scrap was suitable for further use, some of it without any shop or repair work whatever. All this was then put back into service as new material. It was also found that a great deal of the contemplated scrap material could, with very little repair work, be made as serviceable as new, or, with small expense for shop work, be made over to suit other uses.

Aside from salvaging, efforts were also made to decrease the volume of scrap material. All employes of the railroad were instructed to use any material as long as it could be safely employed. A marked decrease in the volume of scrap material was noted.

An idea of the magnitude of the reclamation work may be obtained from the fact that the Corwith shops and storehouses cover a floor space of ten acres, in addition to three docks, and employ about $300,000 worth of machinery. Last year, 8686 tons of material that went through the shops were reclaimed from scrap, and 914 tons needing no repairs were shipped back where required. The net savings, expressed in dollars and cents, on a few of the more important items follow: Brake beams, $9496; coil springs, $5436; track jacks, $5911; switch stands, $7806; tamping picks, $4283; switch chains, $1372; and feed valves, $1170. These are only a few of the many items handled. The total saving accomplished by the reclamation blacksmith shop was $73,246, and the net saving through the work of all the departments was $245,733. The net saving on material that did not need repairs and was shipped back on the road was $76,805. As an example, in one year there were repunched and shipped on requisitions about 3,000,000 tie plates, at a cost of about one cent each. These answered the same purpose as new plate costing about 19 cents each, and involved a saving of hundreds of thousands of dollars. Sold as scrap at the best market price, the old tie plates would have brought only $8000.

As a by-product of the railroad business, the reclamation and salvage department deserves attention. The success of the Santa Fé reclamation work has been noted by other railroads, many of whom have since established similar plants.

TAPER FITS FOR RAILWAY AXLES

By DONALD A. HAMPSON

The making of taper fits is one of the bugbears of manufacturing which can be eliminated only by careful training of employes and a considerable expenditure for special tools, machinery, and gages. Quantity production makes it possible to meet these requirements, and after the machine tools are properly adjusted, and suitable taper reamers and gages provided, the taper fits can be made with very little more trouble than attends the making of straight fits.

On small lot work, the cost of special reamers and hardened gages is rarely justified, and it is necessary to use standard machine tools and equipment. Under such conditions the skill of the workman becomes the leading factor. Often the quality of fit required on small-lot jobs is of the best, which adds to the cost. Production costs increase on any work that requires the accurate locating or positioning of the tapered part. These exacting conditions were met in making the taper fits on some parts for gasoline railway cars in the manner described in the following.

The work consisted of making axles and wheels, which were joined by a taper fit, and of making the complete axle bearings for the truck frames. Details of the taper and the

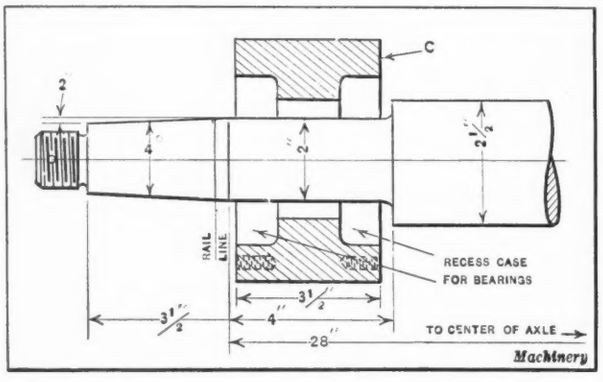


Fig. 1. End of Axle used for Gasoline Railway Cars

roller bearing at one end of the axle are shown in Fig. 1. The wheel to be assembled on the tapered end of the axle is shown in Fig. 3. It was necessary for the parts to be interchangeable, so that repairs could be made without requiring the customer to do any fitting.

Only from one to four sets of wheels and axles were ordered at a time and there was no assurance that the work would increase to such a volume that a fair outlay for tools would be justified. Nevertheless, it was believed that money would be saved on the first two or three sets, if simple tools were provided. The equipment shown in Fig. 2 was accordingly made up at a cost of approximately $25. This simple equipment enabled the workmen to go ahead with the machining operations and feel assured of obtaining accurate results.

The spacing of the wheels on motor trucks and industrial rolling stock does not need to be held within close limits, but the spacing of wheels for railway use, as in the work here described, must be held within limits of 1/16 inch or the wheels will not fit the rails properly.

Gages and Work-holding Chucks

The chuck *A*, Fig. 2, is threaded to fit the lathe spindle nose, and is designed to hold the bearing housing *B*, which is also shown at *C*, Fig. 1. At *D*, Fig. 2, is shown a taper gage made from sheet steel, 3/32 inch thick, which is used as shown in Fig. 3, for gaging the taper bore in the wheel and the location of the face of the hub with respect to the wheel flange. At *E*, Fig. 2, is shown a box gage used to gage the taper on the axle and determine when the tapered portion is located at the correct distance from the center of the axle. The machined part shown at *F* is used as a work-holding faceplate and also as a jig for drilling three bolt holes in the bearing housing and in the bearing caps.

Usually the measurement for the spacing of car wheels on the axle is made from "gage points" on the wheel flanges,

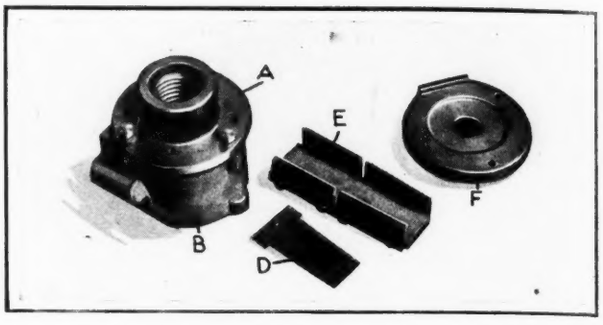


Fig. 2. Fixtures and Gages used in machining Work shown in Figs. 1 and 3

but these points are not the same as the rail lines carried up from the side of the rails. The wheel flange fillets and the rounded corners of the rail heads are not of the same radius, and so no definite shoulders are available for direct measurement. This explanation is given simply to make clear the difficulties encountered in the shop when fitting the wheels to their axles. In the present case, the axle journals are turned to size, using a micrometer to determine when they are of the correct diameter to give a good "hot-water" fit in the roller bearing cones. The "hot water" fit is made by machining the axle to such a diameter that the roller bearing cone can be pressed over it when expanded by heating in boiling water. The ends of the axle are next turned and threaded to fit the retaining nuts, after which the 2-degree taper is machined.

Locating and Gaging Taper on Axle

After the axle is turned down to the required fit in the roller bearing cone, a line is scribed at each end at a predetermined distance from the center of the axle. This line is located at the end of the tapered section, but instead of letting the cut run out at this point, the longitudinal position of the taper is determined by the box gage shown at *E*, Fig. 2. This gage consists of a piece of 1/2-inch steel of the same width as the journal diameter and having one-half its length tapered to correspond with the tapered bore of the wheel. Side pieces are attached to this steel piece with screws, leaving a gap between the parallel and the converging plates.

The scribed line on the axle can be viewed through the gap. This gage fits over the axle, and when it can be pressed against the taper far enough to permit the scribed line to be seen at the end of the plate through the gap, the turning operation is completed. A compound rest is used in machining the taper. Before the final finishing cut is taken on a set of axles, the taper is tested by using the gage *E* with the two parallel sides removed so that any shake or looseness may be felt. The straight and the angular positioned plates of the gage show up any imperfections in the final taper fit, however, better than would a gage designed only to test the tapered portion.

Boring and Facing the Wheels

The boring of the holes in the wheel hubs and the facing of the hub ends is done in a vertical boring mill. The boring mill head is set to the required taper, but this setting is not employed for the finishing cut until the work is checked with a gage that makes contact with both ends of the bored hole. The wheel is chucked in the position shown in Fig. 3,

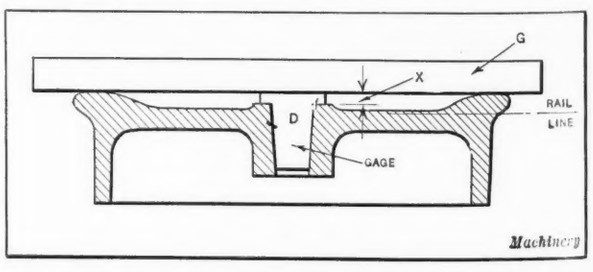


Fig. 3. Flanged Wheel to be mounted on Axle shown in Fig. 1

with the flange side up, so that the hub can be bored and faced at one setting. As the wheel treads and flanges are cast in a chill, they are accurate within 1/64 inch. The usual measuring points on the outside or rail contact side of the flanges are disregarded as checking surfaces, as it involves working from a point on a curved surface. Instead, the tapered gage *D*, Fig. 2, having a shouldered head of such thickness that it can be used for gaging the dimension *X*, Fig. 3, is used.

After setting the boring mill head to the proper taper, all the wheels are rough-bored. The hubs are faced down until the head of the sheet-steel gage will just slip under the steel rail or gage-block *G* placed across the wheel flanges, as shown in Fig. 3. When this test is made, the taper end of the sheet-steel gage projects upward and is not inserted in the bore of the wheel, as shown in Fig. 3. After all the wheels have been thus machined, the tapered holes are enlarged until the gage can be inserted in the hub just far enough to permit its shoulder to come in contact with the faced hub, as shown in Fig. 3.

The thrust of the end nut, aided by a few blows from a heavy hammer, is depended upon to set the wheel properly on its axle. Many of the wheel and axle assemblies thus made have been in service for some time and no trouble from misfits or looseness has so far been recorded. Timken roller bearings are enclosed in the recesses at each side of the cast-iron bearing housing. The two fixtures shown at *A* and *F*, Fig. 2, are used in machining the bearing recess in the housing. The fixture shown at *F* is also used as a jig for drilling the three bolt holes, as previously mentioned. The projecting lip at one side of this fixture serves to locate the holes in the correct position with respect to the flat bearing surface of the housing.

The chuck plate *A* is bored out and threaded to fit the spindle of the lathe on which the housings are machined. The three bolt holes are drilled through both of the fixtures *A* and *F*. This permits the work *B* to be secured to the chuck *A*, as shown in the illustration. The depression in the fixture shown at *F* fits a corresponding projecting lip on the face of the fixture *A*. After machining one end of the bearing housing while it is held in an independent lathe chuck, the work is removed and the finished end secured to the fixture shown at *A*, after which the opposite end of the housing is machined.

* * *

MOHAWK AND HUDSON RAILROAD ONE HUNDRED YEARS OLD

In April, 1826, the Legislature of the state of New York granted a charter to the Mohawk and Hudson Railroad. This enables the New York Central Lines this year to celebrate their hundredth anniversary, as the Mohawk and Hudson is now an essential part of the main line of the New York Central. It was five years from the granting of the charter, however, before the seventeen miles of railroad between Albany and Schenectady, N. Y., were actually placed in operation, when on August 9, 1831, the De Witt Clinton locomotive hauled its first train. The original train on this road attained a speed as high as thirty miles an hour on the level, and in its early travels made the seventeen miles from Albany to Schenectady in thirty-eight minutes.

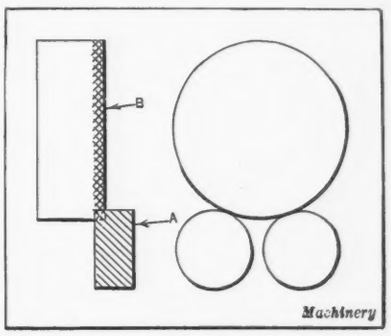
By 1843, twelve years after the opening of service between Albany and Schenectady, nine other small railroads had been built, covering the gaps between Schenectady and Buffalo. At that time it took twenty-five hours to make the journey from Albany to Buffalo, a distance somewhat less than three hundred miles, and required nine changes of cars. In 1853, the first New York Central Railroad Co. came into existence through the consolidation of these ten railroads into one continuous line under a single management. Through the acquisition of connections to Chicago and St. Louis, the New York Central Lines today cover 12,000 miles of main line, with an investment of approximately $2,000,000,000. This railroad system also is one of the two largest in the country, in the amount of traffic handled.

KNURLING OPERATIONS ON MACHINE PARTS

By S. W. BROWN

Knurling, as considered here, is the process of rolling impressions on the peripheries of parts such as hand-nuts, screw-heads, and gage-handles. These impressions are produced by employing a pair of rolls provided with helical or diagonally cut teeth. The teeth on one roll form a right-hand helix, and those on the other a left-hand helix. The knurling rolls are mounted in a suitable holder, and are pressed against the rotating work, thus producing a pattern of attractive appearance when the operation is correctly performed. Although knurling is done mainly for utility rather than appearance, a neat looking job is desirable in most cases. Beginners and sometimes more experienced mechanics are often at a loss to understand why they obtain satisfactory results in knurling some pieces and very poor results in knurling other pieces, the work in the latter case generally presenting an irregular and broken appearance.

The explanation of this difficulty is that there is a certain relation between the size of the work and the circular pitch of the knurl teeth. If the circumference of the work is divisible by the circular pitch, without a remainder, the conditions for knurling are favorable, and good results will generally be obtained. It is probable that the latter condition happens to exist when good results are obtained. On the other hand, if the circumference of the work divided by the circular pitch of the knurl teeth leaves any considerable remainder, the knurl teeth will often "climb" after the work makes one revolution. It is this "climbing" or crossing that causes the knurling to appear irregular and broken.



Method of applying Knurls to Work

Considering the factors mentioned, it would seem that the work should be machined to a diameter which suits the circular pitch of the knurl or that the knurl should be selected to suit the circumference of the work. While this is the proper procedure, it is not generally practiced. In many cases, the slightly imperfect knurling is allowed to pass inspection, as it serves the purpose of providing a good gripping surface for the hand or fingers, although it does not present a good appearance. However, good results can generally be obtained by allowing the knurling rollers to "find" their own circular pitch on the work, as described in the following.

The accompanying diagram shows the position of the knurls *A* in relation to the work *B*. It will be noticed that only a narrow portion of the knurl is in contact with the work. In this position, the knurl is fed rapidly into the rotating work or to nearly the full depth of the knurl teeth, after which it is fed across but not quite off the work. By reversing the feed, the knurl is then fed back and forth until the work is completed. Lard oil should be used as a lubricant in knurling practically all metal except cast iron, which should be knurled dry, care being taken to brush the chips from the impressions while knurling. It might be added that the best results are obtained by holding the work in a chuck and performing the knurling operation first, if there is other machining work to be done on the part.

* * *

The annual report of the General Electric Employes Securities Corporation shows that nearly 25,000 employes of the company own bonds in the corporation, the average holding being $760 as compared with $550 in 1924.

Division of Labor in Tool Manufacturing*

By G. A. PENNOCK, Technical Superintendent, Western Electric Co., Hawthorne Works, Cicero, Ill.

IN the manufacture of telephone equipment, the Western Electric Co. has the problem of making some 110,000 different parts, which are assembled into 13,000 separate and distinct pieces of apparatus. Further, the parts manufactured, while small as compared with those used in automotive, steam engine, or electrical machinery, call in general for a far greater degree of accuracy. The fact, too, that the annual requirements of many of the parts manufactured run into the millions complicates the question still more. Such large requirements necessitate the use of a number of like tools, each of which must conform to very close limits in order to insure complete uniformity of parts, since all assembling is done by piece-work and there is no allowance in the rate for parts that do not fit.

Naturally, the various operations call for the manufacture of a great variety of tools, such as molding and extruding dies, punch press tools of all kinds, intricate fixtures and gages, to say nothing of the thousands of small tools required in the ordinary wood and metal manufacturing operations. As a consequence, we have today at our Hawthorne Plant approximately $12,000,000 invested in tools and $1,000,000 in tool-room equipment. During 1925 we manufactured 4400 major tools at a cost of about $850,000, and $485,000 worth of small tools, such as special milling cutters, reamers, taps, button dies, and wrenches. In addition to these new tools, 30,000 tools were repaired at a cost of $540,000; that is to say, during 1925 our tool-room built or repaired tools of all types at a cost of $1,875,000, and ranging in cost from a $12,000 punch and die to an engraving cutter costing less than 2 cents.

In 1895, or thirty-one years ago, the Western Electric Co. employed 15 toolmakers, and the tool-room occupied about 3000 square feet of floor space. Today the normal personnel of the tool-room is made up of about 600 men. In addition, we have 45 toolmaking apprentices and 88 tool designers, to say nothing of the planning engineers who are responsible in part for the types and designs of tools used. The amount of floor space directly devoted to tool manufacture is approximately 35,000 square feet, and we have some 250 machines of all types, chief among which are 35 milling machines, 40 engine lathes, 20 grinders, 75 bench lathes, 20 drill presses, and 20 punch presses. In 1895, there was just one type of employe, "the toolmaker,"—the all-around craftsman. Today we have about ten general types of employes engaged in our tool manufacture, ranging from planning engineers to machine hands.

Toolmaking Methods Thirty Years Ago

The method of making a tool in the early days was about as follows: As a rule, no tool drawing was furnished. Sometimes a sketch showing the outline of the tool was provided. In other cases, a sample or drawing of the part to be made was all the information the toolmaker had to work on. After receiving the material necessary to build a given tool, he would proceed to lay out the work. Next he would do all the necessary machine work and then proceed to the work of fitting. Practically all die sizing and fitting was done by hand, the method being to file out the die to lines scribed on the face. After the die had been hardened, the punch was milled larger than the die opening and fitted by repeated shearing and filing.

Practically all locations of any importance, such as perforator holes in relation to die openings, or pilot holes in relation to the contour of punches, would be laid out by the use of a gage-block, scratch awl, scale, and, in some very rare cases, by the use of blocks that had previously been made to length with the aid of a micrometer.

When some machine work was to be done, it frequently happened that the toolmaker found several men waiting to use the one available milling machine, lathe, or whatever it might be. Proper supervision could, of course, eliminate this to a large degree, but the condition always existed to some extent. Obviously, the practice of having each man use every type of machine at irregular intervals was a highly uneconomical procedure, as it led to peak loads and idle periods, and as a consequence, necessitated a larger number of machines than would be the case had the work been specialized. Each man, of course, was expected to handle any job that came along—today a punch and die, tomorrow a gage, next week a fixture.

With this picture in mind, let us turn to conditions as they are today. The work is now divided up as follows: (1) Planning; (2) tool designing; (3) tool ordering; and (4) actual manufacturing. We will take up these different steps in order.

Present Methods of Planning Tool Manufacture

Instead of the toolmaker determining the kind and type of tool to be made, the planning organization now does this, based upon the annual demand for the part. If, for example, the annual requirements for a small part are 10,000 or less, the simplest tools are ordered. This is natural, because the cost of producing such a small quantity is almost negligible, compared with the tool cost which would be incurred if elaborate production methods were attempted. If, on the other hand, the requirements are as high as 1,000,000 a year, more efficient and higher priced tools would be justified. For a still larger annual output, only the most efficient tools would be considered, such as multiple tools combining two or more operations and equipped with dial or hopper feeds.

To illustrate this, assume that we are to make a brass washer 5/8 inch in diameter, with a 1/4-inch hole in it. If the demand for this part were 5000 annually, a hand screw machine would be used in its manufacture. This is obviously the cheapest method possible from a tool cost standpoint, since the part would be made from 5/8-inch rod stock and would require only a few general-use tools. Should the demand for the washer be 30,000 annually, the part would be punched from sheet stock on a punch press, using a single-operation tool. A demand of 500,000 or 3,000,000 parts annually would warrant the expense of building a perforating and blanking punch and die that would produce three parts at a time, or seven parts at a time, respectively. The tool cost of producing these parts in accordance with the four methods outlined, would increase from $10 to $600, whereas the production cost of a thousand parts would decrease from $10 to $1.52, and the tool cost would be only 20 cents a thousand parts. The planning engineer, therefore, plays a very important part in effecting economies in tool manufacture.

Designing the Tools

The tool design division is divided into four departments —the punch and die department, the jig and fixture department, the gage department, and the screw machine tool department. The designers in each of these groups work almost entirely upon one particular type of tool, which makes for a more efficient design and lower cost.

With our large requirements, standardizing of tool parts was an obvious step, and as a consequence the tool design

*Abstract of a paper presented at the meeting of the American Society of Mechanical Engineers and the Western Society of Engineers in Chicago on March 24.

division has compiled a complete set of standards. These cover such items as punch and die holders, sub-press frames, die-blocks, liner pins and bushings, dowel-pins, automatic stops, springs, and screws. Much has been accomplished in standardizing our tool designs, thus eliminating the necessity of making a complete tool design for each tool, and standard designs have been made showing the complete standard tool. In the case of a standard punch and die, the only drawing that is required is a lay-out showing the part to be made, which, together with the standard parts previously mentioned, is all the information required by the tool-room to complete the tool. The standard parts to be used are designated on the tool drawing or tool lay-out by the number under which they are stocked.

This standardization allows us to make these parts on a quantity basis and to stock them ready for use, and in addition, provides an excellent line of work on which to train the toolmaker apprentice as well as the specialist. These standards, then, have given us quantity production of parts, and have cut the cost of the tool drawing to a minimum; they also insure adherence to practices that experience has proved to be the best.

Ordering Tools

From the tool design division, the tool order, together with the drawings, goes to the tool ordering organization. This organization checks the estimated cost of the tool, orders standard commercial parts, if any are required, places orders for patterns, castings, or forgings, and follows these orders to insure delivery to the tool-room. It also writes up the order, giving a complete description of tool, final estimated tool cost, a description of the part to be made, etc., and forwards it to the shop with the drawings attached.

Actual Manufacturing Process

In the shop, we find specialization of work, or division of labor, carried to a greater degree even than in the tool design division. The tool-room is divided into the following main groups: The milling machine section, the lathe section, the grinding section, and the bench work section. These main groups are still further subdivided as follows: In the lathe section, we have specialists on threading plug gages and master taps, and still others who turn only circular form tools. The bench work section is subdivided into punch and die work, gage work, and general tool work, including drill jigs, assembling and milling fixtures, screw machine tools, etc.; and in the die gang, we have compound die makers, tandem die makers and forming die makers, who perform only the bench work necessary in the building of these dies.

Routine Followed when Order is Received

Upon the receipt of an order in the tool-room, a record is made of it and the necessary raw material and standard parts already referred to are drawn from stock. The order, work ticket, and material are then passed to the punch and die department, jig and fixture department, or gage department, as the case may be. Next, the material and work ticket are forwarded to the machine departments for the necessary machining. From there they are returned to the die department, if the tool to be made is a die, where the fitting is done. The parts are then hardened by a specialist and returned to the diemaker for the final fitting and assembly.

In this manner, then, every operation has been carried out by a man skilled in that particular work to such a degree that a minimum amount of time is required in setting up work and greater speed and accuracy assured. Further, as the various operations require varying degrees of skill and craftsmanship, help of a lower grade than the old-time toolmaker can be employed on many of them, resulting in lower labor costs. Also, with such an organization, a minimum number of machines and bench positions are required and the work can more readily be scheduled.

Tool Inspection Organization

Upon the completion of the tool, it is routed to the tool inspection organization. Expert tool inspection requires not only ability to interpret drawings and make measurements with great accuracy, but also technical understanding and a sense of the proper and economical use of tools and of the inspection gages to be employed. Not only must the part be produced according to the drawing, but it must be correct for subsequent operations, and when practical, all our tools are given a trial run under shop conditions before they are released for use in the shop. Tool inspection has also become a specialized task, and in most cases, the men in the tool inspection organization are constantly employed on the type of tool on which they have specialized, and in this instance, again, the advantage is a high grade of work at a lower cost.

As an illustration of the degree of accuracy called for on some of our tool work, may be cited the case of a punch and die recently made. The tool was designed to make what is known as the "multiple bank terminal strip," which is used in our automatic exchanges. This part is made of brass 0.020 inch thick. The finished part is approximately 3 feet long and looks like the backbone of a fish, with 129 holes perforated in the spine. Specialists of a high caliber are needed in manufacturing this punch and die. There are thirty-two separate die sections, punch details, and shedder details on 1 1/8-inch centers which must be interchangeable and held to within very close limits, as the total tolerance over the entire tool is only plus or minus 0.001 inch.

This degree of accuracy is necessary in order to meet the requirements of the part to be made, the tolerance of which is plus or minus 0.002 inch over the entire length. A clearance of 0.0005 inch is allowed between the punch and die opening, whereas the perforator openings are only 0.0002 inch larger than the perforators. This 0.0002 inch clearance is extremely important, as if there were less than this, there would be difficulty in pushing the slugs through the die; on the other hand, with a larger clearance, the slugs would be likely to pull back with the perforators. On this basis, the maximum amount that the hole may vary in relation to the perforators is 0.0001 inch. By dividing the maximum limit allowed on the entire length of tool by 32, it will be seen that each one of the sections must be held to very close limits.

The method employed in making this very accurate punch and die is the same as that used on all our die work, as the milling machine work, the lathe work, the grinder work, etc., are all done by specialists, and only the work in connection with the final assembly of the tool is done by the bench hand. The cost of this die was approximately $12,000, and if one man were to attempt its construction according to the practice of twenty years ago, it would require about three and one-half years to complete it. I doubt if one man could do all the work involved in its construction, for the reason that to hold the dimensions required, the highest of skilled operators are required, and to become highly skilled in any one particular operation requires several years' experience. Only an exceptional man could become proficient enough in all the operations to build such a tool successfully.

Comparative Costs by Old and New Methods

A comparison of costs by our present method, as compared with the old methods, will be of interest. It is rather difficult to make such a comparison, but the following case will serve as an illustration. Let us take a theoretical punch and die and estimate the hours of labor required for the various operations, first, when they are all done by one and the same

Operation	Old Method			New Method		
	Hours	Rate per Hour	Total Cost	Hours	Rate per Hour	Total Cost
Lathe work...	9	$1.00	$9.00	6	$0.75	$4.50
Milling work..	10	1.00	10.00	8	0.60	4.80
Drilling work.	8	1.00	8.00	5	0.50	2.50
Grinding work	5	1.00	5.00	3	0.80	2.40
Hardening ...	1	1.00	1.00	1/2	1.00	0.50
Bench work...	20	1.00	20.00	20	1.00	20.00
Totals	53		$53.00	42 1/2		$34.70

man, and second, when each operation is done by a specialist. We will take $1 an hour as a basic rate for a toolmaker, and corresponding rates for the various machine operators.

From the table it is evident that the new method takes only about 80 per cent as much time as the old, and a saving of $18 is made, or a reduction in tool costs of approximately 35 per cent. This is due entirely to the fact that an equal and even better job can be obtained with cheaper grade operators who specialize in one class of work. Further, this does not take into account the fact that by specialization we have reduced the amount of floor space and equipment required to do a given volume of work.

It is not at all surprising that a large economy is made by specialization, since under the old method we see that only 20 hours out of 53 required the services of the high-grade toolmaker at the top rate, and during the other 33 hours he was doing work that could have been done equally well by a machine specialist at a lower rate of pay.

Summary of the Advantages of Specialization

Summing up, the advantages of specialization are as follows:

1. Lower cost of tools.
2. Less time required to build a tool.
3. Economy in high-grade toolmaker's time.
4. Minimum amount of machinery required.
5. Greater opportunity for standardizing parts and operations and thus controlling output.
6. Proper consideration of tool costs, annual requirements, etc., insuring the making of the proper kind of tool.

Were we to revert to the old practices, we would need today approximately 800 skilled toolmakers, whereas we have only about 180 who come into this class. By this division of labor we have also opened up lines of work for the more or less unskilled man, and enabled him to earn wages greater than were hitherto possible. Furthermore, it enables every man to find the niche in industry for which he is most suited, and thus to command maximum wages.

The thoughtless individual, while conceding the efficiency of our present-day methods, is apt to condemn them as monotonous or soul-destroying. The reverse is evidently true, as it has actually raised the type of work the mediocre man can handle and opened up more avenues of advancement for the really able man. This is true not only of our tool manufacture but to an even greater extent of the production end of many big industries. The ability to place men on work where they can produce the maximum output and thus command a maximum return in wages, and at the same time provide a broad field for advancement, is one of the outstanding reasons for the general prosperity of this country today. Prosperity can be assured only by economy of effort, and economy of effort lies very largely in specialization.

* * *

A film has been prepared for the Lincoln Electric Co., of Cleveland, Ohio, showing the use of welding in structural work. This film shows the actual construction of the Peerless Auto Sales Co.'s building in Canton, Ohio—the first all-welded building to be erected in the United States. The owners have arranged to allow technical societies, engineering schools, Chambers of Commerce, and like groups to exhibit the film to their members without charge, except express costs. Those wishing to exhibit this film are advised to arrange for its use through the John B. Abell Organization, 637 Union Trust Bldg., Cleveland, Ohio.

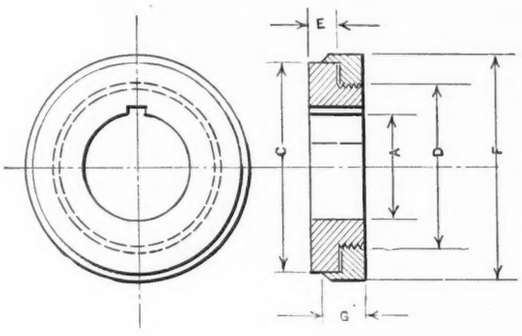
ADJUSTABLE SPACING COLLARS FOR CUTTER-ARBORS

By D. A. ROGERS

In the accompanying table are given the dimensions for making ten different sizes of adjustable spacing collars for milling machine cutter-arbors. The collars consist of two parts, assembled as indicated in the section view. In order to obtain a fine adjustment, a 20-pitch thread is used. The inner or smaller member of each collar is graduated in fifty equal divisions on its outer edge. The beveled edge of the larger sleeve has one witness mark or zero line on it.

Each division on the smaller collar indicates a change in thickness of 0.001 inch, and it is an easy matter to make much finer settings by estimating the fraction of a graduation, as the lines are from 1/8 to 1/4 inch apart, depending upon the diameter of the collar.

DIMENSIONS FOR ADJUSTABLE SPACING COLLARS



No.	A	Thick	Keyway		C	D	E	F	G
			Width	Depth					
1	3/4	3/8	1/8	1/16	1 1/2	1 1/8	3/16	1 5/8	5/16
2	7/8	3/8	1/8	1/16	1 1/2	1 3/16	3/16	1 5/8	5/16
3	1	7/16	5/32	1/16	1 7/8	1 7/16	7/32	2	3/8
4	1 1/4	1/2	3/16	3/32	2 1/8	1 9/16	1/4	2 1/4	7/16
5	1 1/2	9/16	1/4	1/8	2 3/8	1 13/16	9/32	2 1/2	1/2
6	1 3/4	5/8	1/4	5/32	2 5/8	2 3/16	5/16	2 3/4	9/16
7	2	3/4	5/16	3/16	3 1/4	2 7/16	3/8	3	*
8	2 1/4	3/4	3/8	3/16	3 1/4	2 3/4	3/8	3 7/16	*
9	2 1/2	13/16	3/8	3/16	3 1/2	3	13/32	3 11/16	5/8
10	3	13/16	7/16	3/16	4	*	13/32	4 3/16	5/8

Machinery

*Dimensions to suit requirements.

* * *

MEETING OF IRON AND STEEL ENGINEERS

The Association of Iron and Steel Electrical, Mechanical, Combustion, and Safety Engineers will hold its annual convention June 7 to 10 at the Hotel Sherman, Chicago, Ill. In connection with the convention, an iron and steel exposition will be held. Numerous papers will be presented on subjects relating to steel mill operation. Those of general interest in the metal-working field are "Safe Operation of Electric Overhead Traveling Cranes"; "Good Order an Essential for Safety"; "Gas and Electric Welding"; "Personal Problems in Accident Prevention"; "Which Comes First, Production or Safety?"; "Maintaining Interest in Safety"; and "Electric Transportation in Yards, Mills, and Factories." The address of the association is Empire Building, Pittsburg, Pa.

* * *

In 1925, the railroads of the United States spent $754,000,000 in the form of capital expenditures for new equipment, improved facilities and extensions. Of this sum nearly one-half was spent for new equipment, while slightly over one-half was spent on improved roadway and structures. For the last four years the railroads have spent, on an average, $780,000,000 annually for improvements of this kind.

The Development of Tap-drill Sizes*

Results of an Effort Made to Establish a Practical Tap-drill Chart for Production Purposes for Commonly Used Materials

By A. C. DANEKIND

THE proper sizes for tap drills have always been the subject of much discussion. Charts can be obtained from practically any manufacturer of taps or drills which are satisfactory in the majority of cases. However, a careful study of available tap-drill charts reveals the fact that there is no suitable chart for all commonly used materials.

A correct tap-drill chart is very essential to good manufacturing. Too often the choice is left to machine operators who have memorized, through continual use, sizes satisfactory to them. However, if a canvass were made of the recommendations of different operators, much difference of opinion would be revealed. This fact has been proved in the Schenectady Works of the General Electric Co., where practices of several groups were found to be widely different.

In these plants, conditions were found exactly as they are in the general run of manufacturing concerns. Tap-drill charts were conspicuously placed about most of the tool-rooms as a guide for the men in selecting the proper tap drill.

Inquiries were made of the various plants pertaining to the use of tap-drill charts. Each plant reported the use of a chart of its own creation. Many times no two charts would agree on the proper drill for a particular tap. In some cases, the sizes listed, seemed intended to provide over 100 per cent of thread, while in other cases, the thread was nearer 50 per cent of a full thread. One chart called for different-sized drills for right-hand and left-hand taps of the same diameter and pitch. The author believes it safe to assume that many manufacturing plants today are in much the same condition.

Taps were frequently broken off in work in process, which necessitated much extra labor and inconvenience, and investigation showed that incorrect tap-drill charts caused a great number of breakages, through specification of undersized tap drills. This was especially true of machine-screw sizes.

TABLE 1. RECOMMENDED TAP-DRILL SIZES FOR U. S. S. THREADS

Diam. of Tap	Threads per Inch	Tap Drill for		Diam. of Tap	Threads per Inch	Tap Drill for	
		Steel and Copper	Brass, Cast Iron and Fiber			Steel and Copper	Brass, Cast Iron and Fiber
5/16	18	17/64	F	1 7/8	5	1 11/16	1 11/16
3/8	16	O	O	2	4 1/2	1 25/32	1 25/32
7/16	14	U	U	2 1/4	4 1/2	2 1/32	2 1/32
1/2	13	27/64	27/64	2 1/2	4	2 17/64	2 1/4
9/16	12	31/64	31/64	2 3/4	4	2 33/64	2 1/2
5/8	11	17/32	17/32	3	3 1/2	2 23/32	2 23/32
3/4	10	21/32	21/32	3 1/4	3 1/2	2 31/32	2 31/32
7/8	9	49/64	49/64	3 1/2	3 1/4	3 13/64	3 13/64
1	8	7/8	7/8	3 3/4	3	3 27/64	3 27/64
1 1/8	7	63/64	63/64	4	3	3 43/64	3 43/64
1 1/4	7	1 7/64	1 7/64	4 1/4	2 7/8	3 29/32	3 29/32
1 3/8	6	1 7/32	1 7/32	4 1/2	2 3/4	4 9/64	4 9/64
1 1/2	6	1 11/32	1 11/32	4 3/4	2 5/8	4 3/8	4 3/8
1 5/8	5 1/2	1 29/64	1 29/64	5	2 1/2	4 39/64	4 39/64
1 3/4	5	1 9/16	1 9/16	.....	.....	.....	.....

Machinery

Results of Study of Tap-drill Recommendations

A study of the various charts now in existence bears out the fact that the sizes listed are generally too small for production purposes, especially those up to 3/8 inch. This, the author assumes, is due to the fact that the sizes listed are calculated in most cases to produce a thread of approximately 75 per cent, but without consideration of the widely different and peculiar physical characteristics of the materials to be tapped. In some cases, cast iron is classed with steel, wrought iron, and copper, and while it is an accepted fact that the latter three materials have a tendency to spin up when tapped, such is not the case when a sand-cast material is considered.

An analysis of the recommendations of the American Screw Thread Commission reveals the fact that a tap drill falling anywhere between the minimum minor and maximum minor nut diameters—in other words, between 75 per cent and 83 1/3 per cent, with a mean size of about 79 per cent—is listed; this in spite of the fact that most concerns today favor the use of 75 per cent. The author disagrees with this recommendation of the commission. On all sizes larger than 3/8 inch, 75 per cent of thread is ample for all general purposes, provided a good flank bearing is obtained between mating parts. This means threading tools free from excessive lead errors. Practically no additional strength is obtained from an increase over 75 per cent, and lead errors are much more troublesome to deal with, due to the fullness of thread.

To be assured of uniformity in tapped holes, it is necessary to have uniform threading tools. With the use of these tools, however, there must exist a specific guide for tap-drill sizes.

*Abstract of a paper read at the meeting of the American Society of Mechanical Engineers in Providence, R. I., May 3 to 6.

TABLE 2. RECOMMENDED TAP-DRILL SIZES FOR NATIONAL COARSE SERIES MACHINE SCREWS

Nominal Size of Tap	Outside Basic Diam.	Tap Drills (Number Sizes) for Tapping in											
		Bar Stock and Sheets				Castings						Non-metallic Materials	
		Copper	Aluminum	Steel	Brass	Copper	Aluminum	Brass	Cast Iron	Malleable Iron	Die-Castings	Fiber	Hard Rubber
1–64	0.073	53	53	53	53	53	53	53	53	53	53	53	53
2–56	0.086	49	49	49	50	49	49	50	50	50	49	50	50
3–48	0.099	45	45	45	46	45	45	46	46	46	45	46	46
4–40	0.112	43	43	43	43	43	43	43	43	43	43	43	43
5–40	0.125	37	37	37	38	37	37	37	38	38	37	38	38
6–32	0.138	35	35	35	35	35	35	35	35	35	35	35	35
8–32	0.164	29	29	29	29	29	29	29	29	29	29	29	29
10–24	0.190	23	24	23	24	24	24	24	25	25	23	25	25
12–24	0.216	15	15	15	16	15	15	16	16	16	15	16	16
14–24	0.242	5	5	5	6	5	5	6	6	6	5	6	6

Any tap-drill chart can be offered only as a guide. This is due to the fact that tap-drill sizes must vary with the thickness of the materials to be tapped.

Results of Tests to Determine Tap-drill Sizes

The only practical way of determining the proper sizes for tap drills for any commonly used material is by actual physical research. Very carefully tested taps should be used, and drilled holes carefully checked before being tapped. In this way, results can be obtained which can be used as a specific guide in the developing of a practical tap-drill chart.

Whenever metal thinner than three-fourths of the tap diameter or thicker than 1 1/2 diameters is used, a deviation must be made from the recommended chart. As an example, in thin hexagon nuts, practically a full thread is necessary for a fit, because of the short length of engagement, while for work of more than 1 1/2 diameters, less than 75 per cent of thread is often ample, due to the longer length of engagement. When commercial unground taps are used, lead errors are usually present, and a percentage of thread above 75 per cent presents difficulties in maintaining a flank bearing. Considering the depth of the hole to be tapped as falling within the general classifications of from 3/4 to 1 1/2 diameters, the chart offered is correct where approximately 75 per cent of thread is desired.

Drills over 1/2 inch in diameter are standardized into sizes which increase in steps of 1/64 inch. In cases where two drill sizes fall equidistant from 75 per cent, the size of the tap must be considered before a selection can be made. If the size in question is under 1 inch in diameter, it seems logical to recommend the use of the fuller thread, but where 70 to 72 per cent of thread is used on 1-inch or larger sizes, ample thread is obtained for most general production work.

When dealing with machine-screw sizes, a closer choice of drill can be taken advantage of. Through the use of number-size drills, a selection can be made that will produce practically any desired fullness of thread. However, unless the "spining-up" effect is taken into consideration, a difference of but one drill size will affect the subsequent fullness of thread by several percentage points. This, of course, is due to the shallow depth of thread of machine screws. As an illustration, a 40-pitch screw has a double depth of thread of 0.0324 inch. It can readily be seen that a difference of one drill size—about 0.003 inch—will make a difference of approximately 10 per cent in the fullness of the thread. Adding to this the fact that most materials have a tendency to spin up when tapped, it is very necessary that all influencing factors be known before a tap drill is selected.

* * *

PROPOSED CHANGE IN PATENT LAW

According to a letter received from John D. Myers of the Philadelphia Bar, every manufacturer and dealer whose business depends in some degree upon the production of industrial designs, has a vital interest in the legislation now pending in Congress. House Bill 6249 proposes the substitution of copyright for patent protection for designs, and the repeal of the design patent laws. The change sounds simple enough, but owing to the fundamental difference between copyrights and patents, its effects are far reaching. The degree of protection afforded against infringement, for instance, will be much less under the copyright law than under the present patent laws. Manufacturers interested in design protection would do well to investigate these features of the bill referred to, and if found objectionable, to communicate with their representatives in Congress.

* * *

New York City, with approximately 5 per cent of the population of the United States, uses 12 per cent of the electrical energy developed by all the power-generating stations in the country. It is estimated that sixty billion kilowatt-hours of electrical energy were generated in the United States last year. Of this, five billion kilowatt-hours were consumed in New York.

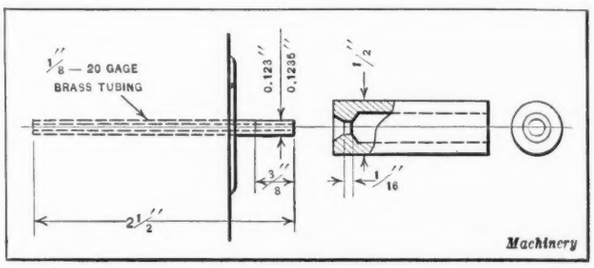
WIRE-DRAWING OPERATIONS ON SCREW MACHINE

By HENRY SIMON

Limits of less than 0.0005 inch, plus or minus, on diameters of screw machine products are usually considered severe, and as a rule, difficult to hold, even on machines which are designed for accuracy and kept in the best shape possible. But there are cases when such limits cannot be held at all with any turning tool, as, for instance, in the example shown in the illustration, where the end of a piece of 1/8-inch brass tubing had to be held to plus or minus 0.0005 inch in order to give the right force fit in a hole in another part.

In this case, a wire-drawing process was employed which enabled the work to be held to even closer limits, without difficulty or additional expense. As the illustration shows, a die similar to those employed for wire-drawing was used, the main difference being that the reducing passage in the die used on the screw machine was much shorter. In this case, it was about 1/16 inch long, and although the tubing was only 1/8 inch in diameter, the work was done on a No. 2 B. & S. automatic. Incidentally, this job demonstrated one use of the collet adapter described on page 384 of January, 1926, MACHINERY.

The die was simply made from a piece of drill rod, hardened in brine and drawn at about 300 degrees F. for twenty



Drawing Die used on Screw Machine to size Tubing

minutes. The orifice was made about 0.001 inch small, and then lapped to size. This lapping operation was quickly done, owing to the short length of the reducing passage. In use, the die can be held in any ordinary turret-holder.

By means of this die, the diameter of the 1/8-inch tubing was reduced as much as 0.0025 inch for a length of 3/8 inch, the time consumed for the operation being one-half second. The tubing varied in size considerably, some of it being almost up to size, but the drawing operation held the work to within about 0.00015 inch, plus or minus. Some 5000 pieces were drawn in this manner with one die. It is hardly necessary to state that this is a "cold" operation, with the spindle dead, or stationary, although the oil was kept running in a good stream. The resulting finish was extremely smooth and even, and better than the finest turning tool could give.

Solid stock of the same size was also drawn, experimentally, and it was found that a reduction of about 0.001 inch could be made successfully. There is no doubt that the same process could be employed to advantage in many instances for a final sizing of fine work of relatively small diameter after finish-turning.

The job illustrated, which nearly taxed the capacity of a No. 2 B. & S. machine, should give some indication of what can be done on both smaller and larger machines. It would seem possible that thin tubular work up to 1/4 inch in diameter could be drawn on this machine if the reduction required were not over 0.00125 inch.

* * *

According to an article in *Automotive Industries*, the average life of an automobile is slightly over seven years. About 1,549,000 cars were scrapped in 1925, so that approximately 40 per cent of the entire output of the industry was required merely for replacement.

Detailed Costs in the Machine Shop

Their Use in Shop Management and in Estimating—Second of Two Articles

By JAMES ALLEN THOMAS

THE price of material is seldom under the control of the shop manager. He must pay the market price, and in this respect stands on the same footing as his competitors. However, the amount of material used can be limited by conservation and preservation against wasteful use. The amount of labor, also, can be greatly influenced by good or bad shop management. No cost system that gives only a general result will supply information that will be a guide for cutting costs. It will not point out the leaks. It will not show where time can be saved in the production of details of a machine, thus enabling the management to meet competition or keep some other product from driving its product out of the market.

The modern shop will spend much money on the installation of labor-saving machinery, buy the highest types of machine tools, and make a big investment in efficient equipment, buy high-speed tool steel, reamers, and drills made of high-speed steel, and then permit the workmen to use them at speeds that are too slow for ordinary carbon steels when used on light, old-fashioned machinery. It is not claimed that detailed cost keeping will remedy such examples of bad shop management, but if the cost system is properly devised and operated, and the information that is secured is used, it will go a long way toward correcting such evils, in spite of bad management.

Value of a Cost System to the Management

A well operated cost system will do as much and be just as big a factor in the successful operation of a machinery manufacturing plant as good management and a thorough knowledge of the business. In fact, really good management is impossible without a good cost system. A detailed cost account is therefore of the greatest assistance to the management of the works and to every one who is at the head of a department. This will be made evident by the use of the detailed cost data that can be collected and compiled covering the different operations on individual pieces of work. When data covering such details of cost are compiled, they are of the greatest assistance to the foreman in cutting costs of production. There is no other way to do this systematically and with any degree of accuracy.

Before a job is started, the foreman may call on the cost department for a schedule of time that would be permissible to allow for all operations on the job, and the cost accountant can furnish this information based on past cost records. Standards for time to be spent on different operations or jobs may thus be established. The records furnished under such a plan are accurate and of use in establishing prices for piece-work, task, or bonus work. These records over a period of time will establish with fair accuracy the efficiency of different workmen, new machine tools, new or different kinds of cutting tools, and other doubtful quantities. When a manager figures the saving he has made by the use of the methods and data cited, he must also take into account the saving of burden that has been made. The same data will also be a guide to the designing engineer as to the most economical design to use.

This use of the cost system as a means of reducing costs is without a doubt the most profitable of all the different functions that it may be made to serve. It is also the one that it is hardest for the proprietor to see, as it looks like nothing but expense. There is nothing tangible to see until the system has been put to work and demonstrated, but there has seldom been a proprietor or manager who has seen it work and noted the benefits derived from it, who did not take it up and carry it out—sometimes even to the point of absurdity in his enthusiasm over its possibilities.

Cooperation between Accounting and Manufacturing Departments

It should be one of the duties of the head cost accountant to call the attention of the heads of departments to any items of excessive costs when he discovers them. A provision for assisting in discovering excessive time items is easily incorporated into the cost system. If properly planned, it may be made a part of the routine of cost keeping at a slight additional amount of a clerk's time.

When this feature is used, the foreman's attention should be directed to the number of hours consumed in doing the work, and comparisons should be made as to hours and not as to wages. An exception to this may be made when it is discovered that high-priced men have been used for doing the work that should have been done by men receiving lower pay. This is a case where the cost accountant is able to direct attention to bad shop management, unless the exigencies under which the work was done made necessary the use of the high-priced men.

It is unnecessary to call the foreman's attention to all cost accounts and excessive amounts of time on every individual job. Such a procedure would be likely to produce just the opposite result from that desired, and besides might take up so much of the foreman's time in analyzing cost accounts that it would leave him little time for his regular duties. An occasional reminder of this kind will keep the foreman "on his toes." The manager or superintendent may call for certain cost accounts and analyze them casually for leaks, or the foreman, if he is zealous in his work, may ask for them so he can check up himself or some of his men. The value of this feature of the cost system cannot be stressed too much. The best way of using it will soon be found by experience, and it will naturally develop according to the particular case in hand and the type of men to be influenced by its use.

This cooperation between the accounting and manufacturing departments can be the cause of a great deal of antagonism on the part of the heads of the manufacturing departments toward the head of the cost department; the latter should engender as little of this feeling as possible, and the heads of the manufacturing departments should accept the information in good part and for the benefit of the employer as well as all connected with the organization. Personal antagonisms are to be avoided between the heads of the different departments; whatever information is wanted from one or the other should be freely given, and the relations between them should not be made personal matters.

All the departments of a plant are closely related, and their interests are interwoven; so are their aims. The production departments are naturally more closely related to each other than the book-keeping, sales, cost, and other non-producing departments are to the producing departments, but they have common interests and are all working to gain the same end. What is for the best interests of one department is also for the best interests of all, and to obtain the best results, all departments must work together. The result desired is the success of the organization, and this can be attained only by complete cooperation

of all departments. This may call for a little diplomacy on somebody's part at times, but cooperation should be the general rule always.

Use of Detailed Costs in Estimating

One of the most beneficial results obtainable from a thoroughly detailed cost accounting system is that of getting costs of the individual items or component parts of the machinery being built. Obtaining a general cost result is only one of the functions of a good system of keeping costs, and when close competition is to be met, the general cost is of the least value. It has its uses and is a very necessary function of any cost system, but there are other equally valuable functions that a cost system can fulfill, and detailed costs properly compiled so as to be available for estimating purposes is one of them.

All the cost records obtained by a system of keeping detailed costs may not be of future use, as is the case in building a machine that would never be reproduced. But in the average plant building either a special line or a variety of different things and doing it as a regular business, the cost system with this feature embodied in it has the greatest value. The cost of the different items will assist in calculating to a nicety the approximate cost of some other type of machine that may be totally different but have parts similar to those used in other machines. In this respect, the detailed cost system is of the utmost value to the estimator, as it assists in making estimates that are more accurate than can be made upon the basis of any other data.

The cost estimate probably will have to be made by an engineer who is familiar with the design of the machine being estimated on, and he will also have to be acquainted with what has been built in the past by the factory. Such details as he will require may most easily be found by looking up the drawings of machinery that has already been built. The detailed costs must be compiled in such a manner that allowances can be made for changes in wages, prices of material, and changes in burden. When the costs have been properly compiled, these allowances can easily be made by the estimator. If a change in the class of material is desired in the estimate, this may also be easily taken into account.

Advantage of Grouping Costs of Related Parts

For the convenience of the estimator, it would be well for the cost department to group the parts of a machine in the cost account, so that parts which are related to each other will appear in proper sequence and in such a manner that the total cost of the group will be shown in the cost account; for instance, the body of an engine connecting-rod should be followed by the brasses, wedges, or gibs and keys, etc., and these footed up to give the cost of the group, which would be the total cost of the completed connecting-rod. The complete headstock or other major part of a lathe should be handled in the same manner.

When it is necessary to quote a price on any part of a machine, the estimator can get the cost of such part from past cost records with reasonable assurance that the cost is correct. It will be well for the estimator to review several cost accounts of like or similar jobs, to insure accuracy, or to avoid getting a labor charge that is unreasonable one way or the other. It requires intelligence on the part of the cost accountant to compile records that will give this service, and the estimator must use the records intelligently. When such records of cost as are referred to here are available, the estimator will be able to estimate the cost of a job correctly within a very small percentage.

After the cost records have accumulated for a time, it will be possible for the estimator to make up an estimate on a machine that has never been built, from the cost records of a lot of different machines, and know that his estimate is fairly correct. Thus to a large extent the factor of guesswork has been eliminated, and the estimate is based on what actually has been performed.

REPAIRING ENGINE LATHES

By JACOB H. SMIT

The bearings of lathe spindles often become worn on one side due to the thrust of the cut being always in one direction on outside turning operations. This is particularly likely to happen if the spindle is not adjusted when it becomes slightly loose. In time, the spindle will be thrown out of line so that a hole, for instance, will be bored tapered with a small diameter adjacent to the headstock. The usual way to realign the spindle is to loosen the headstock and place paper shims at the opposite corners. This method may be all right if the corrections must be made in a hurry, but when it is decided to really overhaul the lathe, a good deal more work is required.

First make an arbor to fit the spindle socket and turn it straight for a length of at least 6 inches for use later on in inspecting. Then take out the spindle, remove the cone pulley, and press off the main gear. If a cylindrical grinding machine is available, it is best to take a light cut off the journals of the spindle or else file these portions. Next lay the spindle in the bearing boxes, insert the test arbor in the spindle and inspect the test bar for parallelism with the ways by means of an indicator mounted in the toolpost. This test will show whether the spindle lines up with the ways of the bed. It will be convenient if the test bar is of the same diameter as the tailstock spindle, because then the heights of the headstock and tailstock spindles can be measured easily at the same time.

When it is known how much the spindle is out of alignment, its bearings should be scraped to suit. Prussian blue can be used on the spindle to show up the high spots of the bearings. During the operation, the test bar should be checked from time to time with an indicator. If the spindle bearings consist of half boxes, a light shim should be put between the halves when reassembling. This shim can be taken out when the lathe has been run for some time and the bearings again require a slight adjustment. The bearing bolts should also be tightened, but not drawn up the entire amount, so that if the bearings become slightly loose, the bolts can be pulled tighter to take up the clearance. The clearance between the spindles and the bearings should be greater with high speeds than with low speeds, because of the larger amount of heat developed with high speeds.

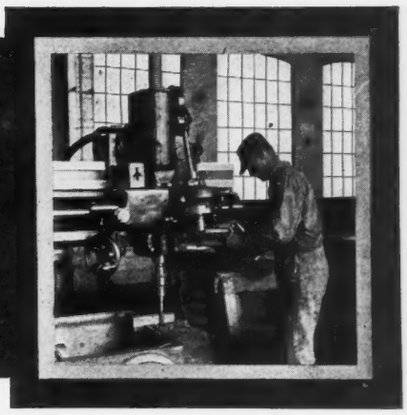
The best way to line up the tailstock spindle with the headstock spindle depends on the design of the headstock and tailstock. If the spindle bearings are half-boxes, shims can be placed underneath the bottom boxes to raise the spindle. When the headstock and tailstock spindles have been realigned, the faceplate should be mounted on its spindle and the front tested by means of an indicator while the faceplate is revolved. If the faceplate runs out of true, a neutral point may be found and marked with chalk. A straightedge should then be laid across the faceplate to check it for straightness. The cross-slide may next be checked for squareness with the spindle by feeding the indicator across the neutral point of the faceplate by means of the cross-slide. If the cross-slide is out of alignment, the slide and its bearings on the carriage should be scraped to suit. The compound rest should next be scraped, and lock-nuts provided for all gibbed screws.

As the feed-screws are used often, it is well to face off their thrust collars and file or scrape the surfaces with which the collars contact. The feed-screw nut should also be examined to make sure that there is no movement in the nut itself, and the zero marks on the feed-screw dials should be checked. It is assumed that the bed requires no scraping, as this is seldom necessary, but if it does, it should be scraped before any reconditioning is done on other parts.

* * *

What standardization has meant in the automotive industry is exemplified by the fact that in the course of a single year, the various divisions of the General Motors Corporation use 3,000,000,000 standard parts in the manufacture of automobiles.

Letters on Practical Subjects



BORING FIXTURE FOR CONNECTING-RODS

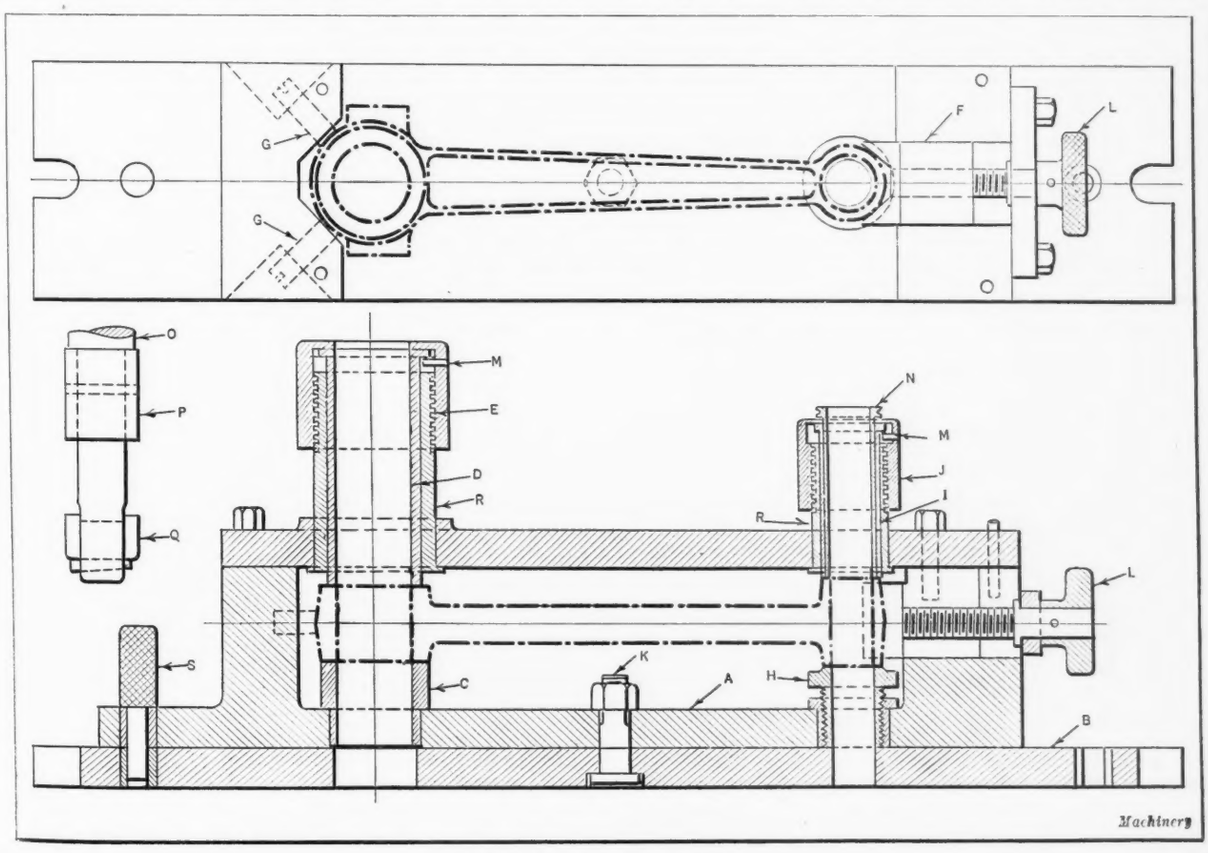
The fixture shown in the accompanying illustration is employed on a single-spindle drilling machine for drilling or boring the holes in the ends of connecting-rods. The body *A* of the fixture, on which the connecting-rod is clamped, can be swiveled on the base *B* about the stud *K* to bring first the large end of the connecting-rod under the drill spindle, and then the small end. The connecting-rods, one of which is indicated by the heavy dot-and-dash lines, are straddle-milled to the correct width on the large end, the hole in this end being cored if the rods are of steel or malleable castings. In the case of small connecting-rods, the small end is left solid.

The connecting-rod is placed in the fixture with the machined face of the large end resting on the steel bushing *C*. The clamping bushing *D* is then brought down in contact with the other face by means of the knurled nut *E*. This serves to level the rod or bring it into a horizontal position, and brings the faces of the rod into the required position at right angles with the spindle of the drilling machine. The rod is clamped lightly on the two machined faces, so that a lateral movement may be obtained by adjusting the V-block *F* by means of the knurled-head screw *L*. This movement of the V-block forces the large end of the rod between the centering screws *G*, and centers the small end of the rod on the supporting bushing *H*. The nut *E* is next tightened, using a spanner wrench, if necessary, to obtain a firm grip on the work. Ordinarily, however, a spanner wrench is not required in clamping small 12-inch rods like the one shown.

As there is more or less variation in the height of the small end of the rod, the supporting bushing *H* is made adjustable. This bushing is next adjusted until it bears lightly against the work. The clamping bushing *I* is then turned down by nut *J*, until it rests on the top face of the small end of the rod.

After one end of the connecting-rod is bored and reamed, the nut on the swivel stud *K* is loosened, the index-pin *S* withdrawn, and the fixture swung around to bring the opposite end of the connecting-rod under the drilling machine spindle. The pin *S* is then replaced and the nut on stud *K* tightened.

The pins *M* are inserted in the nuts *E* and *J* in order to permit the latter members to withdraw the clamping sleeves when the clamping nuts are loosened. The bushing *N* is employed to guide the first drill used, and is withdrawn when the larger drill is used. The shank of the boring tool for the



Boring Fixture for Connecting-rod

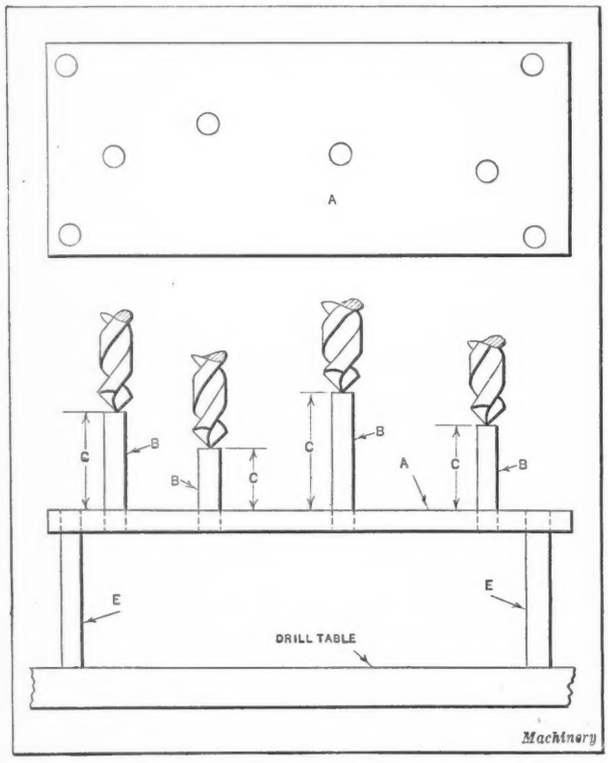
large end of the connecting-rod is tapered to fit the drilling machine spindle, and has a hardened sleeve *P* which is a close running fit in the bushing *D*. The double-end cutter *Q* is centered by means of a notch that fits the flattened sides on the shank of the tool, and is held in place by a tapered key, as shown. The cutter is ground after being mounted on the holder.

One cut is taken in the cored hole of the connecting-rod, which is followed by reaming. The hole in the small end of the connecting-rod is first drilled 1/16 inch under-size, after which a three-lipped drill 1/64 inch under-size is used. The final finishing cut is taken by a reamer. The sleeves *R* are made a press fit in the top plate of the fixture. The fixture is so mounted that the chips fall through the hole in the drilling machine table.

Algona, Iowa — GEORGE W. WILSON

DRILL-SETTING FIXTURE

When a number of holes of various depths are to be drilled with a multiple-spindle drilling machine, time may be saved by employing a fixture such as shown in the accompanying illustration for setting the drills to their correct heights. The fixture is inexpensive to make, and consists primarily of a steel plate *A*, the cold-rolled steel pins *B*, and the four pins *E* which serve as feet. The difference in the heights *C* of pins *B* must be the same as the difference in the depths of the holes to be drilled. In replacing the drills after grinding, the fixture is simply set on the drill table, and the drill points allowed to rest on their respective locating pins while tightening the chucks on their shanks.

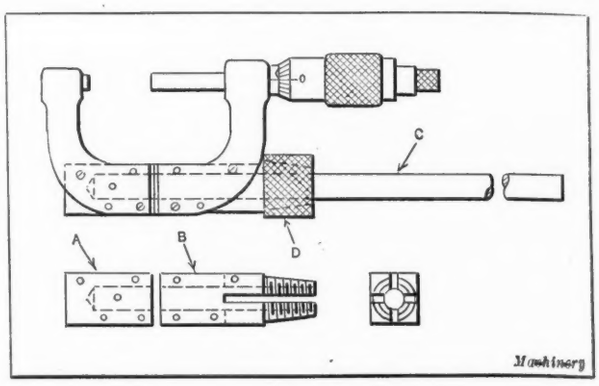


Fixture for setting Drills in Multiple Drilling Head

Philadelphia, Pa. — CHARLES KUGLER

A 24-INCH MICROMETER MADE FROM A 2-INCH MICROMETER

In the accompanying illustration, is shown a 2-inch micrometer equipped with an extension rod *C* which permits it to be used for measurements from 2 to 24 inches. It is of rugged construction and there is little danger of its accuracy being impaired, even when used by inexperienced workmen. Originally, it was constructed by the writer for use in measuring the punch and die members of a 24-inch blanking die which required close fitting. However, it has since proved useful for much of the general run of work.



Micrometer provided with Extension Rod

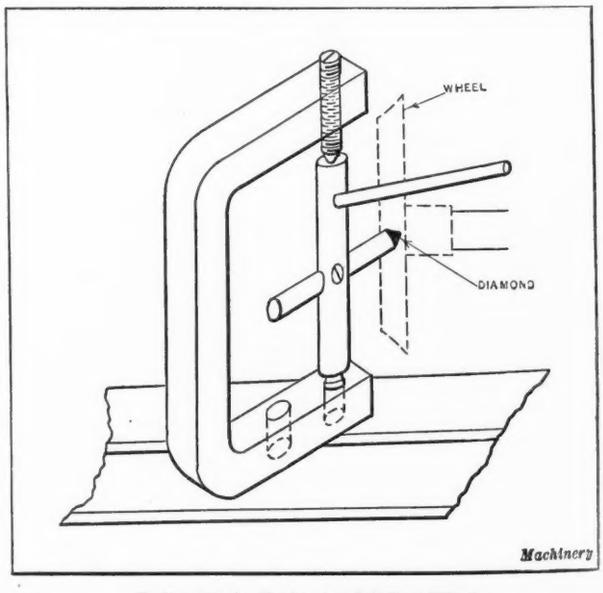
The first step in equipping the micrometer with the extension rod was to obtain two pieces of cold-rolled stock *A* and *B*, 3/4 inch square by 1 1/2 inches long. These pieces were secured to the frame of the micrometer by means of screws and dowel-pins, as indicated in the illustration, care being taken to have the ends of the blocks in contact. A hole was then bored and reamed in these pieces to fit the extension rod *C*, which is a piece of 3/8-inch drill rod.

After the blocks were drilled and reamed, the micrometer frame was split through the middle with a 1/32-inch saw. By properly positioning the sliding member of the micrometer on rod *C*, pieces of any length ranging from 2 to 24 inches can be measured. It will be noted that the hole for rod *C* is not drilled completely through the block *A*. The block *B* is threaded at one end with a tapered thread, and has four slots which permit the end to be contracted by tightening the knurled nut *D*. Thus the sliding member can be easily clamped in any position by simply tightening the knurled nut.

Rockford, Ill. — GEORGE CHRISTIANSEN

RADIUS TRUING DEVICE FOR GRINDING WHEELS

The radius truing device for grinding wheels which is shown in the accompanying illustration can be quickly and cheaply made. A piece of 1 1/4-inch square cold-rolled steel is bent as shown, and drilled and tapped at both ends to receive adjustable centers. A short piece of round stock 1 inch in diameter, is centered and fitted between the centers. This part is provided with a handle of 1/4-inch cold-rolled steel, as shown. It is drilled in the center to receive the diamond holder which is made from a piece of 1/2-inch



Radius Truing Device for Grinding Wheel

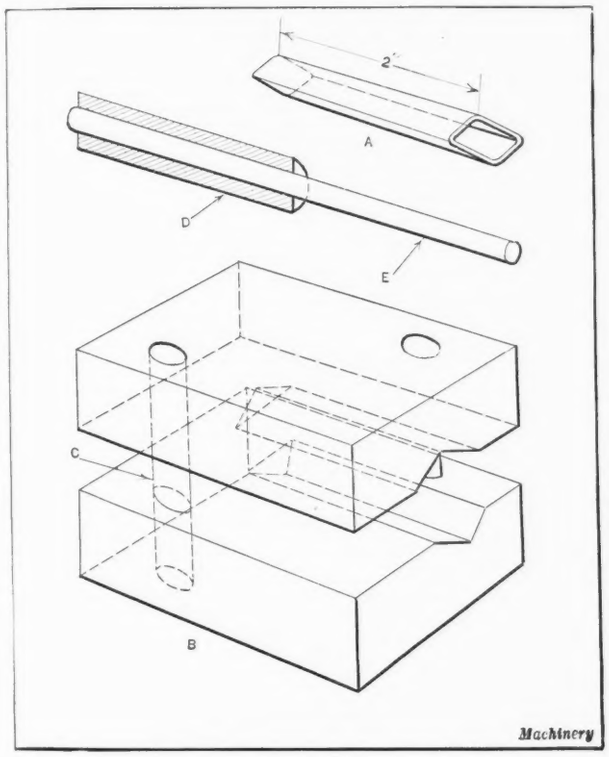
brass stock. The diamond bar is adjustable by setting it in or out to get the desired radius, and is then locked with the set-screw. A 5/8-inch hole is drilled in the bottom of the frame to permit bolting the device on the machine table. It can also be clamped in a small vise, which is sometimes more convenient.

Seneca Falls, N. Y. H. L. WHEELER

DIE FOR TUBE FORMING

The die here described was used in an emergency to produce several hundred irregular-shaped tubes like the one shown at *A* in the accompanying illustration. The die shown at *B* has a recess corresponding to half of the tube to be formed, sunk in each half member. The two halves of the die are kept in alignment by the guide pins *C*.

At *D* is shown a half section of a soft rubber mandrel on a steel core *E*. The outside diameter of this mandrel is such that its volume is the same as the internal volume of the finished tube. A piece of round tubing is placed on the mandrel and then held in the die under an arbor press. The



Die for forming Tubing

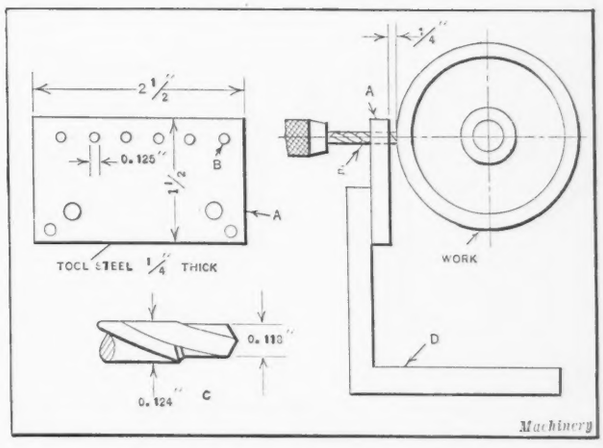
tube is thus pressed out to conform to the shape of the die, any tendency of the walls to crush or buckle being prevented by the rubber mandrel.

Cleveland, Ohio HERBERT W. CABLE

DRILLING PIN-HOLES FOR FEED WHEELS

Wheels having pins that project from their peripheries are employed in various machines for feeding perforated material. In the production of these feed-wheels, it is desirable that some means be provided for drilling the pin-holes accurately to size and correctly spaced. Let it be assumed, for instance, that it is necessary to drill a lot of twenty-five wheels, each wheel to have 120 evenly spaced holes of 1/8 inch diameter, arranged in rows of six each. The limited number of wheels required does not warrant the building of an expensive drill jig, but the work cannot be done at a profit without using special tools. As a solution, the inexpensive equipment here illustrated was provided.

The first step is to make a plate such as shown at *A*. A row of six holes, correctly spaced and located, is drilled and



Jig used in drilling Pin-holes in Feed Wheels

reamed in this plate. Screw and dowel-holes, as shown in the lower side of the plate, are also drilled. Next several twist drills are ground, as shown at *C*, to adapt them for drilling and reaming the pin-holes at one operation. The drilling is performed on a milling machine, the work being mounted on a shouldered arbor, one end of which is held by the dividing head, while the other end is supported by the footstock center.

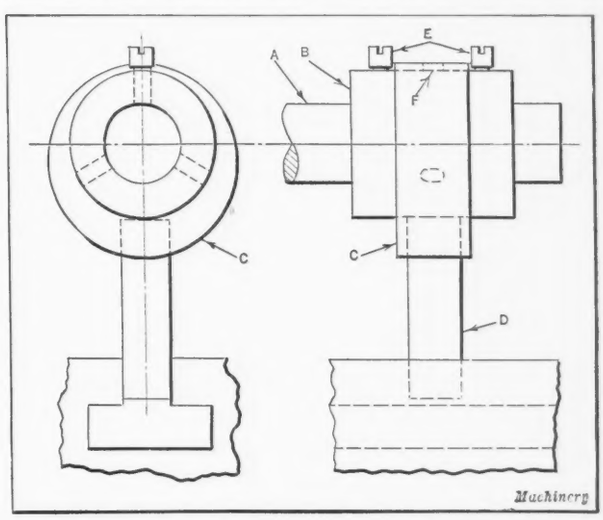
If a sufficiently fast speed cannot be obtained on the milling machine, a high-speed drilling attachment may be employed. Plate *A* is clamped to an angle-iron *D* with the center of the row of holes set at the same height as the center of the work. The plate is then secured to the angle-iron by screws and dowels, after which the angle-iron is bolted to the milling machine table in the correct longitudinal position and set parallel with the work at a distance of about 1/4 inch, as shown in the view at the right-hand side of the illustration.

A small chuck is next mounted on the milling machine spindle or the spindle of the high-speed milling machine attachment, and the drill *E* gripped in the chuck. The spindle and one of the holes in the plate *A* are next brought into alignment ready for drilling. The circular spacing is obtained by means of the indexing head in the usual manner, and the longitudinal spacing by aligning the drill successively with each hole in the plate *A*. The table feed-screw dial is employed in making these settings.

Pawtucket, R. I. S. W. BROWN

INDEXING DEVICE

In small shops not equipped with regular milling machine indexing heads, it is necessary to provide some sort of spacing device whenever work that requires indexing must



Indexing Device used in milling Three Equally Spaced Slots in Shaft

be done. A device that was designed in a case of this kind for indexing a shaft is shown in the accompanying illustration. The shaft *A*, in which three equidistant slots were to be milled near one end, was held on V-blocks on the milling machine table and indexed by means of the device shown.

The first step in making the indexing device was to drill and ream the piece *B* to fit shaft *A*. Next another piece *C* was bored out eccentrically to fit over part *B*. Part *C* has a pin *D* driven into a hole in the heaviest side. This pin is a close fit in the milling machine table. Two screws *E*, fitted in tapped holes in part *B*, served to secure part *B* to the work *A* and at the same time to hold part *B* in place. Piece *B* has three equally spaced holes drilled in its periphery, and part *C* has a sight-hole *F* of the same size drilled through the thinnest part at the top.

When the device is in use, a shaft is slipped through the collar *B*, the two screws *E* are tightened, and the end of the pin *D* is located in the T-slot of the machine table before the work is tightened in the V-blocks. The shaft is also adjusted until one of the holes in part *B* lines up with the sight-hole *F*. After cutting one slot, the piece is indexed to bring the next hole in *B* in line with hole *F*, and the same procedure is repeated for cutting the third slot. Quite accurate spacing of the slots was obtained with the device described, which can be readily produced in almost any small shop.

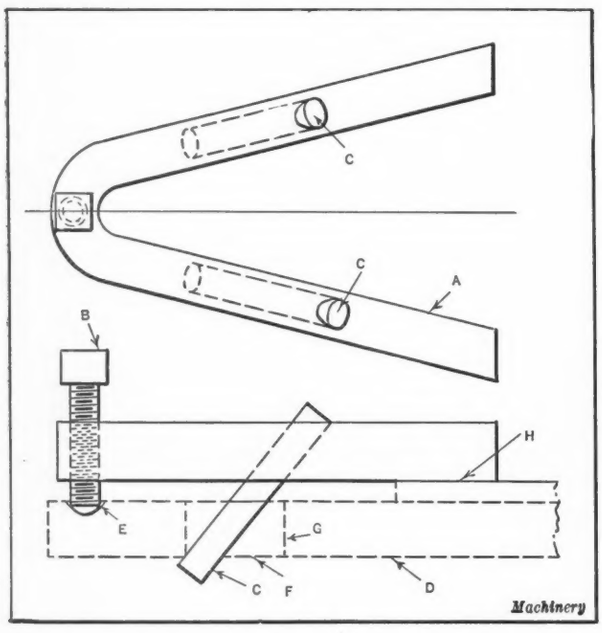
Montreal, Canada — H. Moore

DOUBLE-WEDGE CLAMP

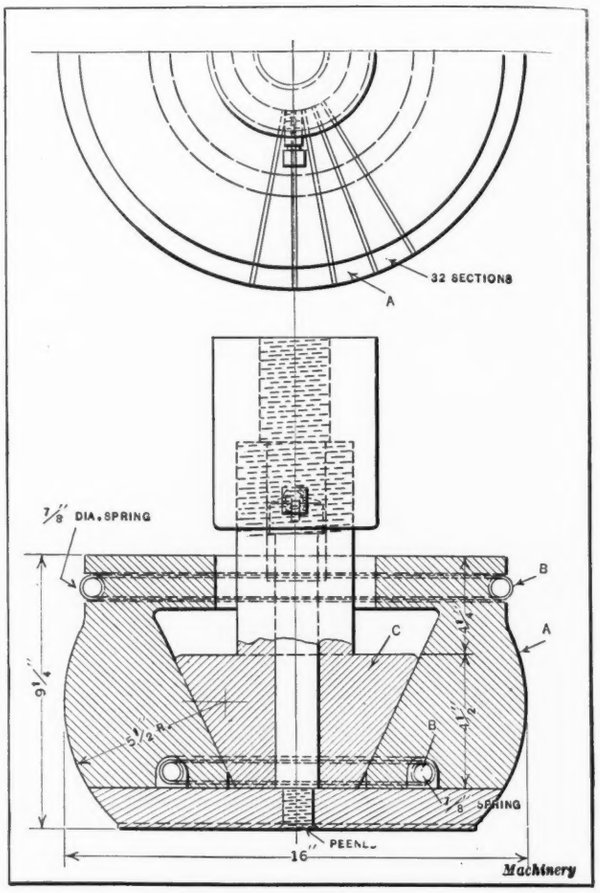
It often happens that the clamps used to strap work down must be entirely removed at each setting in order to permit the chips to be cleared away and the work slid into place. The double-wedge clamp shown is designed especially for use in such cases when the work is held on a clamping plate.

The clamp body *A* is made from square stock bent to a V- or U-shape as indicated, and tapped to receive a screw *B* at the bend. Two holes are drilled at about a 45-degree angle to receive the pins *C*, which are tightly driven into place. The plate *D* is prepared for use with a clamp of this kind by machining a spherical recess to fit the end of screw *B* and machining two holes or openings *F* to receive the pins *C*. The position and diameter of recess *E* and the holes for pins *C* must be such that at no time will the pins touch the forward part or side *G* of the holes *F*. Reference to the illustration will show clearly how easily the clamp may be put in place or removed and how, when screw *B* is tightened up, pressure is brought to bear on the work at the point *H*.

Montreal, Canada — Norman Moore



Double-wedge Clamp



Details of Construction of Bulging Die

BULGING OR EXPANDING DIE

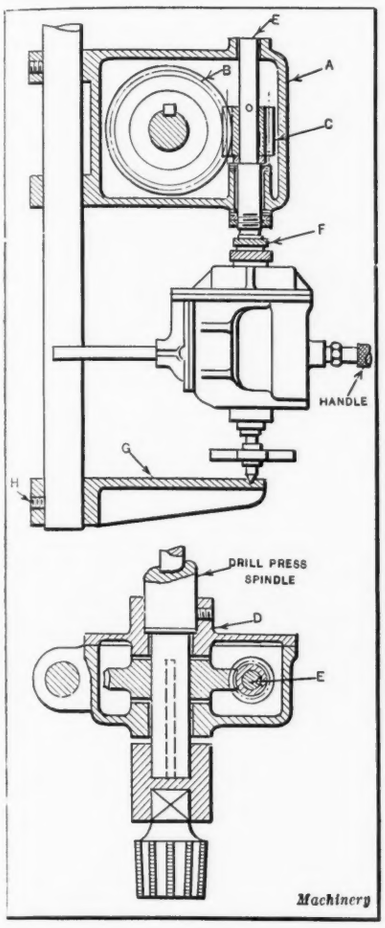
In the accompanying illustration is shown a type of bulging or expanding die which can be operated in a single-action press if there is sufficient die space. The particular die shown, however, was too large to be used in any single-action press available, and it was therefore necessary to operate it in a large drawing press, allowing the carrier for the blank-holder to run free. It will be noted that the die is shown in the expanded position. The bulging portion of the die is made up of thirty-two sections machined from cast iron, one of which is shown at *A*. These sections are drawn together by two coil springs *B*. When the sections are contracted or drawn together, the tapered member *C* is in the upper portion of the cone-shaped cavity.

Chicago, Ill. — A. P. Ufer

IMPROVISED AIR-DRIVEN TAPPING MACHINE

The problem of tapping a large number of 3-inch holes in the bottom of some cast-iron tanks used in a water purification system was recently encountered in a jobbing shop. As none of the drilling machines available were heavy enough to drive a tapered pipe thread tap of this size, a long wrench manipulated by two men was at first employed. This was satisfactory while the tap was new, but after it became somewhat worn three men had difficulty in doing the work. In order to facilitate the tapping of the holes in the tanks, an attachment such as shown in the accompanying illustration was made.

A cast-iron gear-box *A* containing a 6-inch worm-wheel *B* and a driving worm *C* was made. The collar shown on the cover *D* was made to fit over the spindle of the drill press and was used only as a means of steadying the attachment. The worm-shaft *E* was machined with a Morse taper shank to fit the spindle *F* of a large reversible air drill. This drill was held in place on the bar by means of a bracket *G* secured



Air Drill arranged to drive Tap

in place by a set-screw *H*. By employing an air pressure of 80 pounds per square inch to drive the tap, a full thread could be obtained in about one minute. Only one man was required to operate the tapping device, and a saving of 1/2 to 3/4 of an hour in the time required to tap each hole was made.

A reduction in speed of 36 to 1 was obtained by the worm-gearing contained in the gear-box *A*. The worm-gear was made from cast-iron and the worm from steel, the moving parts being packed in cup grease. The radial bearing bushings were made from plain bronze, and the thrust of the worm was taken on fiber and brass washers which have been found to withstand this service without appreciable wear. The attachment was inexpensive to construct and has paid for itself many times over. Although a 3-inch tap is the largest size tried, there is little doubt that a 4-inch tap could be driven by the attachment. Practically perfect threads have been obtained, and no trouble has been experienced from stripping or misalignment of the tap, as frequently happens when tapping the holes by hand.

Frederick, Md. ERIC LUNDGREN

ARTIFICIAL SEASONING OF HARDENED PARTS

Tool-steel parts are subject to more or less distortion as a result of the hardening operation. Distortion from this cause continues indefinitely, but is most marked during the first few months after hardening. Considerable difficulty is experienced with test bars and mandrels as a result of this condition.

Some manufacturers season their mandrels by storing them for several months after hardening and rough-grinding. At the end of this seasoning period, the work is finish-ground. This natural process of seasoning is effective, and is probably more reliable than any artificial process employed for the purpose. It has one fault, however, in that the length of time required renders the process prohibitive in many cases. Hence, the manufacturer is often confronted with the alternative of omitting seasoning entirely or employing some process of artificial seasoning.

The principle of artificial seasoning is based on the assumption that it is not the length of time but the different temperatures incident to the seasoning period that produce the desired results. Therefore, it is assumed that the same results can be obtained by subjecting recently hardened parts to alternate heating and cooling a number of times in succession, the entire process consuming only a few hours. Acting upon this theory, the writer tried out such a seasoning process on a lot of parts with good results. These parts were tool-steel rods, 3/16 inch in diameter by 3 1/2 inches long, with a tapped hole at each end. It was necessary that the parts be hardened, ground, and lapped true, as they served as guides for a sliding member.

After hardening and rough-grinding, the pieces were placed in a perforated container and immersed alternately in boiling water and ice water, being allowed to remain ten minutes in each bath. This process was continued for one hour, and was followed by a twenty-four-hour rest, after which the parts were finished to size. Two kinds of steel were used for the parts, and equally good results were obtained with each kind.

Pawtucket, R. I. S. W. BROWN

CUTTING A GEAR ON A SHAPER

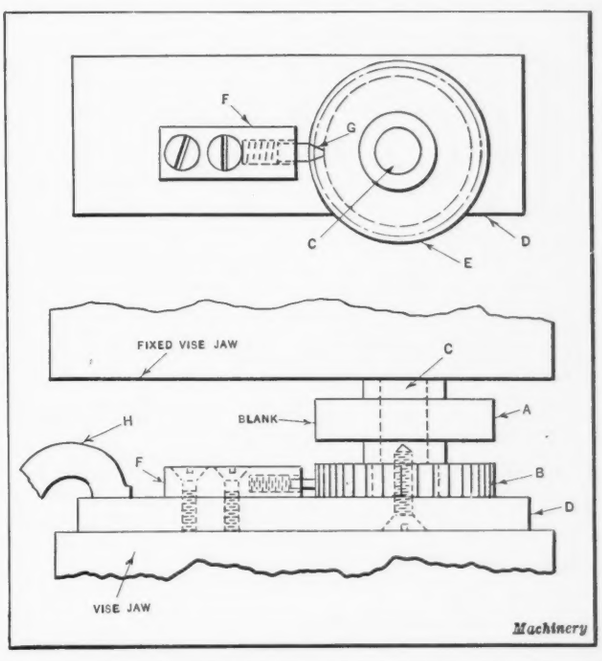
Having a small gear of twenty teeth to make for a repair job, the writer rigged up the indexing device shown in the accompanying illustration for cutting the teeth in the shaper. After making the gear blank *A*, a gear *B* of nearly the same diameter as the blank but having forty teeth was found, and a spindle *C* made to fit both the gear *B* and the blank. The gear and the blank were then doweled together so that they could be turned together freely on the spindle. The spindle was next secured to a piece of flat iron *D* by means of a flat-head machine screw. The spindle was so located that the gear and the blank cleared the bottom of the shaper vise but extended above the vise jaws at *E*.

A piece of square key-steel *F* was then drilled and fitted with a spring pin *G*. This piece was located on the flat iron piece so that the pin engaged the teeth of the gear *B*. The whole assembly was next clamped to the loose jaw of the shaper vise by means of a C-clamp *H*, after which the gear and the blank were clamped between the vise jaws, and the first tooth space cut with a shaper tool ground to the correct form. After cutting the tooth space, the tool was raised, the vise jaws loosened, and the blank and gear turned or indexed two tooth spaces on the gear *B*. The vise jaws were then tightened and the next tooth space cut. This operation was repeated until all the teeth had been cut in the blank. The indexing fixture can be used for cutting any number of teeth that is a multiple of the number of teeth in the indexing gear *B*.

Elsmere, Del. PAUL F. RAVILIOUS

* * *

The mechanical power used in the United States exceeds that used in all other countries combined.

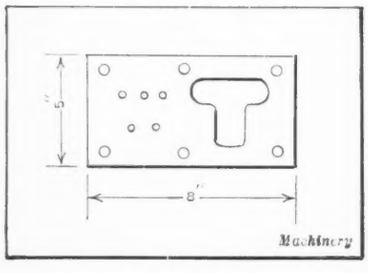


Indexing Fixture used in cutting Gear on Shaper

Shop and Drafting-room Kinks

HOW DIES ARE HARDENED TO PREVENT CRACKING

In hardening dies such as shown in the accompanying illustration, trouble is frequently experienced from cracking. To prevent this, the writer fills all the small holes with fireclay, and places the die in a gas furnace. As the die begins to heat up, it is turned around several times, in order to keep the heat uniform throughout the piece. Great care is taken to prevent any part of the die from becoming overheated, because when this once happens, considerable damage is done to the structure of the steel. When the die reaches the proper heat for the particular steel used, the heat is shut off, and the die lifted out carefully and held up endwise to prevent warping. It is then plunged into a bath of lukewarm water and moved up and down in the bath.



Die to be hardened

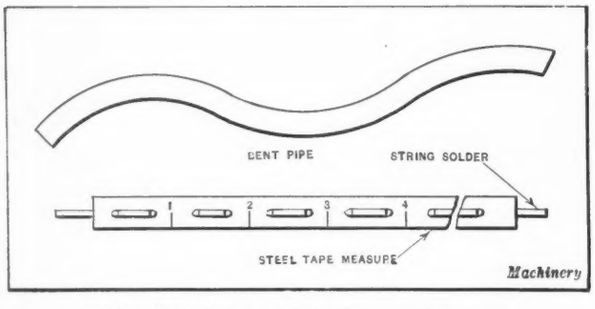
While still sizzling hot, it is removed from the water, put in a tank of oil, and allowed to become nearly cool. While it is yet too hot to be held in the hand it is removed and tested for hardness. If it is found to be extremely hard, it is immediately rubbed off or polished with emery cloth, placed on a red-hot iron, and drawn down to a light straw color. The die is then cooled off in water. It is desirable to prolong cooling as much as consistent with the obtaining of the required hardness. Briefly stated, no overheating and no hurried cooling are essential for success. The method of hardening here described is applicable to any high-grade water-hardening tool steel having a carbon content of from 0.70 to 1.05 per cent. The steel should, of course, be heated to the temperature recommended by the maker, which may be from 1420 to 1500 degrees F.

Rockford, Ill. GEORGE CHRISTIANSEN

TAPE FOR MEASURING BENT PIPE

The steel tape shown in the accompanying illustration is used in a large shipyard for finding the length of bent pipe. The tape has holes punched through it at regular intervals, and through these holes is woven a piece of string solder. A drawing is first made of the pipe to as large a scale as possible, after which the tape is bent to conform with the contour of the drawing. The string solder serves to hold the tape in any position to which it is bent, and thus permits accurate measurement of bent pipes that would be difficult to measure in any other manner.

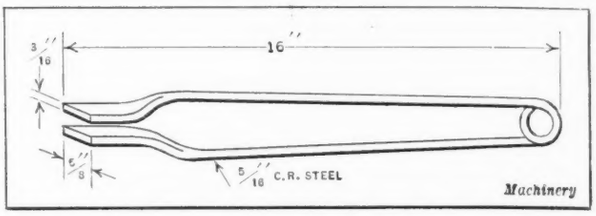
Philadelphia, Pa. CHARLES KUGLER



Outline of Bent Pipe and Tape for measuring Length

TONGS FOR HANDLING SMALL WORK

The small tongs shown in the accompanying illustration are a useful addition to the machinist's kit of tools. They are especially useful when hardening or soldering and brazing small pieces. The tongs shown are made from a piece of 5/16-inch round, cold-rolled steel, but the design can be used for larger or smaller sizes. A piece of the required length is clamped in a vise at its middle point, and the free end wound around a piece of steel about 1 inch in diameter. The jaws are then formed on each end of the piece by heating and flattening on a blacksmith's anvil. After forming the jaws, the ends are again heated and bent to the required position with the opposing surfaces parallel with each other when the jaws are closed. The spiral turn will normally hold the jaws open, and only a light pressure of the hand is required to close the jaws on the work.

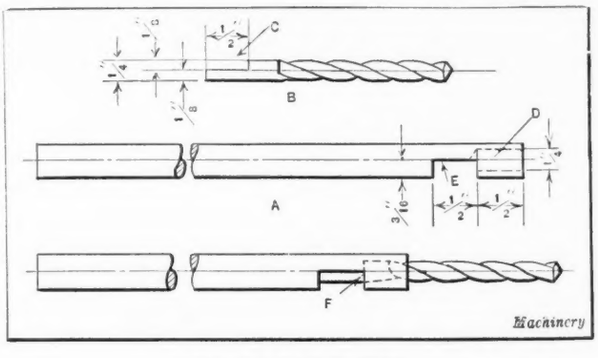


Tongs for Small Work

Seneca Falls, N. Y. H. L. WHEELER

EXTENSION SHANK FOR DRILLS

An extension shank for a drill, tap, or reamer is shown in the accompanying illustration at *A*. The dimensions given are for a 1/4-inch drill, and would, of course, be changed to suit the size of drill or tap used. First file, grind, or mill a flat on the shank of the drill *B*, as shown at *C*. Next drill a hole *D* in the end of the rod, the same size as the drill to be used. Then mill, shape, or file the slot *E* in the extension, and place the drill in the hole *D*. A little solder at point *F* serves to hold the drill in place. The resulting extension is efficient and has a workmanlike appearance.



Extension Shank for Drills

Bloomfield, N. J. GEORGE W. JAGER

SECURING PAPER TO DRAWING-BOARD

A convenient and effective method of holding drawing paper in place on a drawing-board or on a glass surface is to employ small squares of friction tape cut from a fresh roll. Small pieces of the tape can also be used to hold tracing cloth in place on a drawing.

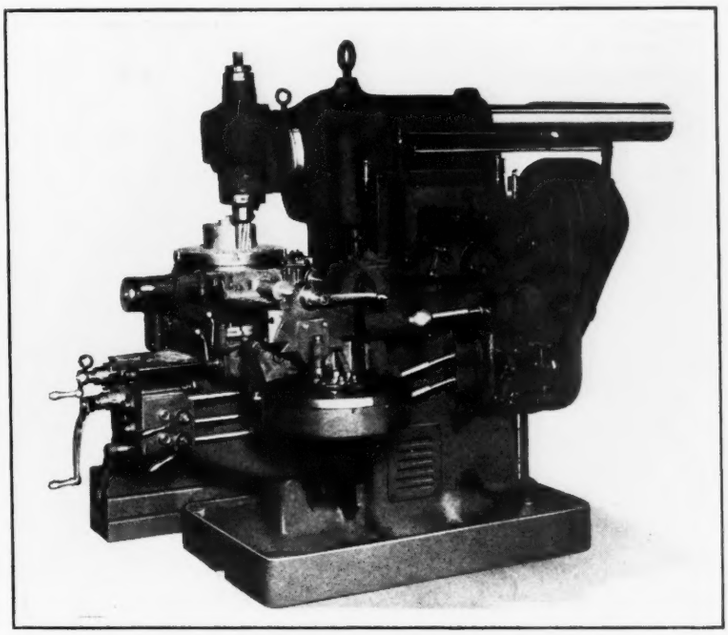
Everett, Mass. DEXTER W. ALLIS

SOLVING A CAM MILLING PROBLEM

In a large hosiery plant using considerable machinery of foreign manufacture, much trouble was experienced in replacing master cams that wore or broke. There are about six of these cams to each knitting machine, and it is essential that the size and finish be maintained, or else poorly woven hose is the result. The high tariff on machine parts coming into this country, together with the long delay on foreign shipments, made it desirable to make replacement cams here.

The cams are now made in a Kempsmith No. 2 plain "Maximiller" equipped with a type F vertical attachment, as illustrated. The lead-screw of the machine was removed to permit a free lengthwise motion of the table, and a 16-inch circular attachment was fastened to the table. The circular table was geared in such a way that its movements were identical with those of a similar table bolted to the right-hand end of the saddle of the milling machine.

The master cams are removed from the knitting machines and securely clamped to the lower circular table. About five or six of the cam blanks to be cut are mounted on the circular attachment of the regular table. In the milling operation, the circular attachment on the table is fed in by hand to the required depth of cut, after which the power feed of the table is engaged. The cam blanks are fed in the desired path around the milling cutter as a guiding pin follows the master cam. The pressure of the cutting tool against the cams being cut, and the pressure of the guiding pin against the master cam, are maintained by means of large weights suspended from the machine table. By milling six cams simultaneously, a large amount of time is saved. The attachments can easily be removed to permit the machine to be used for other toolroom work.



Equipment provided on a "Maximiller" for milling Cams

* * *

RIGHTS OF SELLERS IN INTERSTATE COMMERCE

In presenting his annual report before the twenty-first annual convention of the National Supply and Machinery Distributors' Association held in Atlantic City late in April, George A. Fernley, secretary-treasurer of the association, called the attention of the members to the rights of a manufacturer, distributor, or dealer as regards those with whom he shall do business. "Court decisions during the past year," said Mr. Fernley, "have placed additional emphasis upon the rights of manufacturers to supervise the distribution of their products. Several years ago, the United States Supreme Court, in the celebrated Beech Nut Packing Case, distinctly stated that the seller has a right to sell or to refuse to sell as he sees fit."

Commenting upon the recent important decision of the United States Circuit Court of Appeals in the case of the Federal Trade Commission versus the American Tobacco Co., it was mentioned that the court not only reiterated previous decisions to the effect that a seller has a right to refuse to sell to a buyer who has cut the prices suggested by the seller, but that a seller has the right to refuse to sell to a buyer where the buyer has cut prices fixed by a trade association. It is to be observed that in so doing the court did not sanction the right of an association to fix prices, for that is clearly unlawful; but in spite of such unlawful act upon the part of the association, the court upheld the right of the American Tobacco Co. to refuse to sell to dealers who had cut the prices which had been fixed by the Wholesale Tobacco & Cigar Dealers' Association of Philadelphia. This is the most important decision with regard to this matter that has been rendered since the decision of the Beech Nut Case. It firmly fixed the right of a seller to refuse to sell to a buyer who has cut the prices suggested by the seller, and it does so upon a stronger basis than has ever been declared by the courts.

Later during the convention, Felix H. Levy, former special counsel to the Department of Justice, spoke on "The Remedy for Price Cutting," pointing out that the courts have definitely decided that, while a manufacturer must not have any agreement with a distributor or dealer as to the price that the latter is to charge for the products of the manufacturer in reselling them, he has a perfect right to refuse to sell to a dealer who cuts prices, and he is at liberty to state the reason why he does not wish to have any further dealings with such a distributor. It is the seller's right to sell or refuse to sell for reasons sufficient to himself. The important point is that he must have no agreements of any kind—verbal or in writing—relating to the resale price, but the distributor or dealer must be perfectly free to charge any price that, in his judgment, is to the best interest of his business. The manufacturer, in turn, has an equal right to refuse to supply a dealer whose methods of doing business, in his opinion and for reasons sufficient to himself, are detrimental to the manufacturer's interests.

Mr. Levy also pointed out that recent court decisions have made it very clear that members of trade associations have a perfect right to openly discuss any subject whatsoever relating to their industry. They may discuss production, past prices, price cutting, methods of distribution, and any other topic of vital interest to each of them individually, provided the discussion does not lead to any agreement to which any member need consider himself bound, but that each member is free to act in his own business according to his own judgment, in the light of such information and knowledge as he may gain through the open and free discussion in the meeting of an association.

* * *

GEAR-TOOTH ACCURACY

An error in printing in the insert advertisement of the National Tool Company, Cleveland, Ohio, in May MACHINERY, gave the limit to which gear tooth contour is held as *0.0005 inch*. This should read *0.00005 inch in contour*—a very important difference.

The limits were correctly stated in the insert advertisement published in April, and in the editorial description of the gear tooth grinder appearing in the same month.

The Machine-building Industries

As emphasized last month in this review of the machine-building field, the three basic industries that determine to a large extent the business activity in most other directions are the iron and steel industry, the automobile industry, and the building industry. When these are active, the prosperity of the railroads is also assured, because of the traffic offered to them.

In all three of these fields, great activity can still be recorded. The iron and steel industry shows a slight recession from the virtual boom during February and March, but the drop in operation is comparatively small, and the industry as a whole is operating at from 80 to 85 per cent of capacity, with stocks in the hands of buyers small.

In the automobile field, there appears as yet to be no slackening of production. It is evident that the present high-level operation cannot be maintained indefinitely, but reports indicate that only two of the large companies are producing cars at a lower rate than the anticipated schedule. There is some doubt, however, whether their retail sales in all cases justify the present production schedules; but such questions have always been raised in regard to the automotive industry, and in only two or three instances have the builders overestimated the possible sales. The truck and bus business is unusually good, with record production.

The building boom is still with us, and, while there are some indications of a slackening of pace in this field, the contracts let this year are, so far, considerably ahead of those let during the same period last year. It would not be surprising, however, to find the building activity settling down to a more normal rate, the past year's record being in the nature of a boom.

The Federal Reserve Bank's report of business conditions leaves nothing to be desired. It records increased production in the basic industries for March, the last month for which complete statistics are available. One feature of particular importance in the Reserve Bank's report relates to the sales of agricultural machinery and equipment, which are gaining by appreciable percentages. Both domestic and foreign business in this field have continued to show an expansion since last November. The total sales for 1925 were over 30 per cent greater than in 1924, according to a compilation made from the reports of 114 manufacturers of agricultural machinery and equipment in the United States.

The Machine Tool Industry

As mentioned in this review last month, the new business booked in the machine tool field in March showed a material advance over the average for the first three months of the year. In April, there was a recession in the case of most machine tool builders, although several report increased business in April, as well. The foreign trade in machine tools will doubtless be adversely affected by the British strike, and while generally the export business is a comparatively small percentage of the total machine tool business at the present time, its effect will be felt by some manufacturers who have enjoyed a considerable volume of foreign business.

Machinery Exports During the Past Year

Figures compiled by the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce show that the exports of metal-working machinery from the United States in 1925 had a value of $22,000,000, as compared with $14,600,000 in 1924—an increase of about 50 per cent. In this field, Great Britain and Germany are the most important competitors, and it is, therefore, of interest to note that during 1925, the United States shipped over $4,000,000 worth of metal-working machinery to Great Britain, and nearly $3,000,000 worth to Germany. It is especially significant to note that while Great Britain imported over $4,000,000 worth of metal-working machinery from the United States, the British exports of this class of machinery only reached $7,540,000, or not quite twice the imports from the United States. The imports from the United States into Germany equalled approximately 15 per cent of the German exports of metal-working machinery.

Europe now takes 62 per cent of the metal-working machinery exports of the United States, the largest percentage of our exports since 1919. Latin America takes 12 per cent of the exports. The value of the exports of metal-working machinery to Asia is ten times as great as previous to the war.

In 1925, the United Kingdom was the greatest market for American metal-working machinery, Germany ranking second, France third, Canada fourth, Italy fifth, Japan sixth, and Russia in Europe seventh. The three countries first mentioned take about 43 per cent of the total exports.

The Automobile Industry

It is estimated that the sales of new cars this year are 20 per cent above the 1925 volume, but as the sale of a new car at present almost always means the turning in of an old car in exchange, the stock of used cars is said to be the largest in the history of the automotive industry. High records of production have been reported by several companies, and even some concerns that have reduced their production schedules materially are, nevertheless, doing a much larger business than during the same period last year.

The Canadian tariff reduction on automobiles has caused a great deal of discussion. Some of the important manufacturers who maintain Canadian plants are planning to discontinue them, doing all the manufacturing on this side of the border; others, including Ford, will continue their Canadian plants.

The Railroad Situation

Car loadings continue to run heavier than last year, but the railroads are in such excellent condition in regard to surplus equipment that no difficulty is experienced in moving the freight with unusual dispatch. The earnings of the railroads have reached the highest level since the war.

There is no evidence of any letting up in traffic. Considering the machinery industry alone, it is expected that shipments of electrical machinery during the second quarter of the year will require, on an average, 30 per cent more car equipment than during the same quarter in 1925, and an increase of 15 per cent in the shipment of machinery in general is anticipated by the Atlantic States Shippers' Advisory Board, covering the industries in the Middle Atlantic states. The board also stresses the fact that no difficulty has been experienced so far this year in securing the necessary railroad equipment for shipments, although car loadings have exceeded those of any previous year.

The railroads have over 200,000 surplus freight cars in good condition and ready for service, and new cars are being added at the rate of 6000 to 8000 a month, with some 50,000 cars still on order. On May 1 the number of domestic locomotives on order exceeded 700. Generally speaking, the roads are buying equipment more freely than in 1925.

* * *

The machinery imports into Poland increased from $4,400,000 in 1924 to nearly $6,000,000 in 1925. The increase was due to gains made during the first six months of 1925. A business depression starting in August, which caused currency fluctuations and money stringency, together with governmental restrictions, limited the imports during the latter part of the year.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

WARNER & SWASEY UNIVERSAL TURRET LATHE

A new 3-A universal turret lathe, designed to accommodate both bar and chucking work, and intended for small-lot, as well as quantity-production work, constitutes the latest addition to the line of machines built by the Warner & Swasey Co., Cleveland, Ohio. One of the principal features of this machine is the provision of patented covers, which completely protect the ways of the bed from grit, chips, or cutting lubricant, in order to maintain the original accuracy of the machine for a long period of time. Wear on the ways caused by dropping chuck wrenches or tools on them is also prevented by the covers.

The capacity of this machine is considerably greater than that of previous 3-A machines, the capacity through the chuck for round bars being up to 7 1/2 inches in diameter, and the maximum turning length, 39 inches. For chucking operations, the machine is regularly equipped with a 22-inch chuck, the maximum swing over the covers for the ways being 25 1/4 inches, and over the carriage of the square turret, 18 inches. Other features included in this machine are a geared headstock, turret and turret-binder constructions, power feed trains, provision on the apron for making feed changes, and improved carriage and saddle stops.

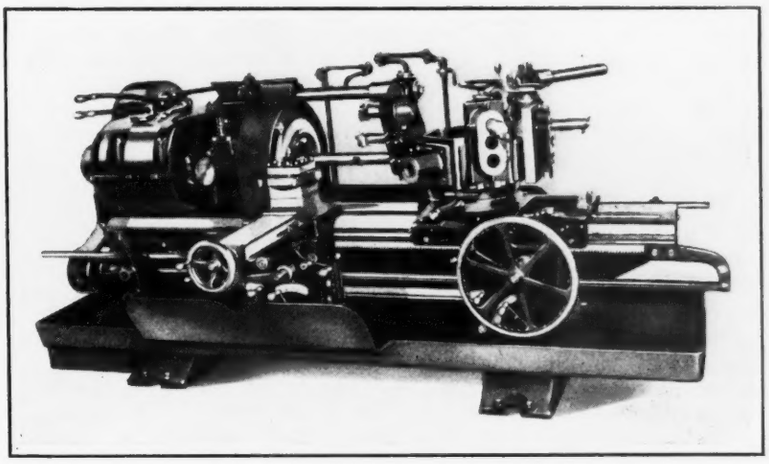


Fig. 1. Warner & Swasey Turret Lathe equipped for Chucking Work

All the ways are kept constantly covered, even during simultaneous operation of the hexagon turret and the square turret in different positions along the bed. The construction of the covers is shown in Fig. 3, from which it may be seen that a pressed-steel main top cover, fastened to the left-hand side of the hexagon turret saddle, runs the entire length of the front way to the left of the saddle. This cover passes through an inverted V-slot in the square turret carriage which permits the cover to move with the hexagon turret saddle independently of the square turret carriage. The left-hand or free end of the main top cover is supported by the main cover support, which is a heavy cast-iron member attached to the square turret carriage and moving with this carriage. The support provides solid metal between the main top cover and the way, so that heavy chucks or work may be rested on the cover or fall on it without damaging it. In order to prevent chips from working up beneath the main top cover in the space between the hexagon turret saddle and the side carriage, a lower way guard is provided, as indicated. This guard is attached to the right-hand side of the square turret carriage, moves with it, and passes into a slot in the hexagon turret saddle.

The way at the back of the bed is protected by a heavy rolled cover fastened to the hexagon turret saddle and resting directly on the way. This cover enters a tunnel at the back of the all-geared head. Two short covers are also fastened to the right-hand end of the hexagon turret saddle to prevent chips from falling on the ways at the end of the bed. To provide a reliable method of lubricating the enclosed ways, the square turret is fitted with an oil plunger pump, which can be easily filled from an ordinary oil-can. Oil is fed with pressure by this means to the ways. Means are also provided for lubricating both ways of the hexagon turret.

The head of the machine is cast in one piece with the bed, and is provided with heat-treated alloy steel gears running in oil. A maximum input of 25 horsepower can be transmitted, although a 10-, 15- or 20-horsepower motor is used for the average range of work. While flood lubrication is provided for the entire head, the main spindle bearings are constantly supplied with clean oil from cups. Twelve spindle speeds, both forward and reverse, are instantly available. A new feature is that the front and back shafts, and also the drive shaft, run in taper roller bearings which have an adjustment for end play. This construction makes possible a narrower arrangement of the head in the front and rear, so that the cap-bolts of both spindle bearings are readily accessible. The use of the roller bearings also increases the power transmitting efficiency.

The spindle nose is threaded for fastening the chuck securely, but the pilot is tapered instead of being straight. This gives a bearing that is said to insure alignment in mounting chucks or fixtures. In case of wear at any time throughout the life of the machine, it is possible to dress up the taper and the front shoulder to a new and accurate fit. Babbitt metal is used for the main spindle journals, as this metal will absorb any foreign materials which may enter the bearings and thereby render them harmless to the spindle. Starting, stopping, and reversing the machine are accomplished through a large duplex clutch on the back shaft, which is equipped with bronze and steel friction members.

The hexagon turret is of the familiar heavy hollow type, with broad faces to which the tools and holders are bolted from the inside. Accurate alignment for center-piloted or overhead-piloted bars and other tools is insured by means of projecting bosses which enter the holes in the turret faces. A vertical lock-bolt located immediately under the working tool is used to lock the turret accurately in any of its six positions. The center pivot stud is tapered and cast solid with the turret. It fits into a tapered bushing in the saddle, which is adjustable to permit maintaining accurate alignment. The turret is clamped to its seat by means of a patented outside split-ring binding mechanism. This ring has a double taper, which hugs corresponding tapers on both the saddle and turret in the same manner as on the 1-A machine described in October, 1924, MACHINERY. A single lever operating a right- and left-hand screw is employed for tightening the ring.

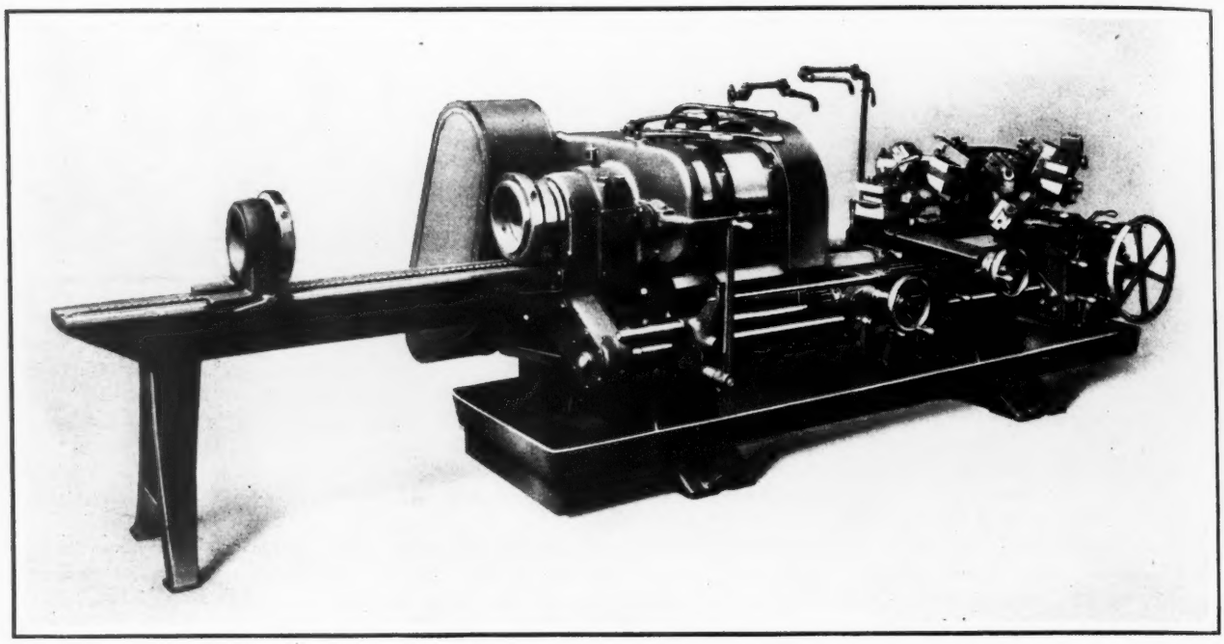


Fig. 2. Universal Hollow Hexagon Turret Lathe arranged for Bar Work

In order to lessen operating fatigue, a power rapid-traverse has been provided for moving the hexagon turret to and from its working position. It can be arrested at any point. On the return stroke from the work, the rapid-traverse lever is kept automatically in engagement, but it is disengaged at the end of the stroke without attention from the operator. The device operates in a bath of oil. There are sixteen feeds for the hexagon turret, eight of which are readily obtained by operating levers conveniently located on the turret apron. An additional lever is manipulated to operate a doubling gear in the gear-box at the head end of the machine and thereby make eight more feeds available. The feeds range from 0.005 to 0.167 inch per revolution of the spindle.

The turret feeds are engaged and may be reversed by levers also contained on the saddle apron. They are automatically disengaged by adjustable stops on a roll located between the vees. The stops can be quickly and accurately set, which is an important feature with small-lot work where the set-up time must be kept low. An entire set-up of tools can be moved toward or away from the spindle without disturbing the stops on the roll, and the entire roll can be thrown out of engagement.

To provide for rigidity, the square turret carriage is anchored to a third rail or guide near the bottom of the bed on the front side. Thus the cross-slide does not reach across the bed, and it has been possible to bring the spindle center, hexagon turret, and square turret close to the bed without sacrificing the maximum swing over the square turret carriage. The design also permits running the square turret out of the way to the left, past the chuck, when the chuck and work are less than 18 inches in diameter. Four or more forged tools can be held on the square turret at one time. It is indexed without being lifted from its seat, and can be clamped in any position by giving a quarter turn to the binder handle. The narrow construction of the square turret permits feeding the hexagon turret close to the work without interference.

The new feed arrangement also provides sixteen longitudinal and sixteen cross feeds for the square turret carriage, and these may be operated either in forward or reverse. The longitudinal feed may be automatically disengaged by six adjustable screws mounted on a revolving spool in the apron. To assist the operator in operating the cross-feed, a large dial is mounted on the screw near the handwheel which facilitates accurately gaging the depth of cuts. This dial is graduated in thousandths of an inch and equipped with numbered metal clips that provide for accurate repetition of settings.

Cutting lubricant is supplied by a geared oil-pump of the blade type, which is coupled direct to the power-traverse drive shaft. This pump delivers lubricant at the rate of six gallons per minute. A plain countershaft equipped with oil-tight roller bearings in the hanger boxes and in the loose pulley, is furnished as standard equipment. When a motor drive is provided, a compact mounting for the motor is obtained by means of a vertical plate attached to the rear of the leg at the head end of the machine. The motor is mounted on a standard slide base, so that belts can be tightened by adjusting the position of the motor.

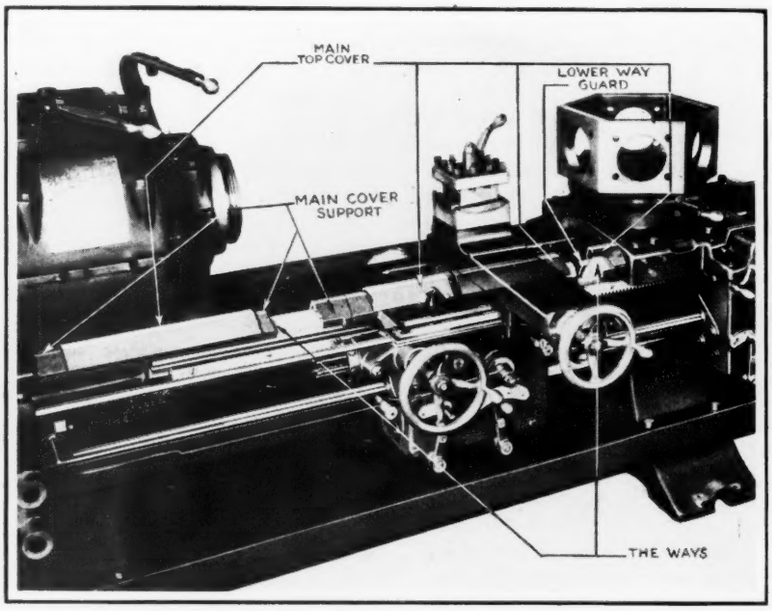


Fig. 3. Arrangement of the Covers that protect the Bed Ways from Grit, Chips, or Cutting Lubricant

The standard bar equipment for the machine includes a 22-inch, three-jaw geared scroll chuck; a ratchet bar feed with work support, two universal turners, and a pointing or chamfering tool; short- and long-flanged tool-holders; a 3-inch automatic opening die-head; and a tool-stand. The overhead-pilot set of chucking equipment

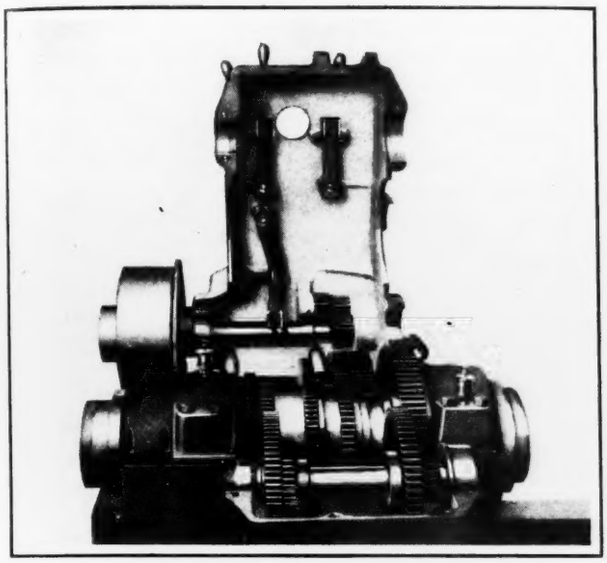


Fig. 4. Construction of the All-geared Headstock

provided consists of a 22-inch, three-jaw geared scroll chuck; two multiple turning heads; two slide tools; short- and long-flanged tool-holders; two center-pilot boring bars with boring heads; and two center-pilot bars with spindle bushing. Additional supplementary equipment includes taper and threading attachments, stub boring-bars, a center-drilling tool, and additional turret tools. A standard machine tool data sheet is supplied, which contains complete information for checking tool interferences, planning work, making factory layouts, time studies, etc.

KEARNEY & TRECKER MILLING MACHINE

At the convention of the American Railway Association in Atlantic City this month, the Kearney & Trecker Corporation, Milwaukee, Wis., will exhibit a No. 4 milling machine embodying several new features such as a power rapid traverse in three directions, a spindle gear train equipped with Timken tapered roller bearings, and self-oiling universal joints. The spindle itself is mounted in tapered bronze bearings, which can be adjusted from the outside. Eighteen changes of speed are available through ten gears, as in other machines built by this company.

Power rapid traverse is provided for the table, saddle, and knee. With the rapid traverse, the table can be fed longitudinally in either direction at the rate of 150 inches per minute; the saddle can be fed in or out at the rate of 70 inches per minute; and the knee can be fed up or down at the rate of 50 inches per minute. All power rapid-traverse movements in any direction are controlled from the front of the machine, and are obtained through a multiple-disk friction clutch.

There are two separate automatic pumps, one of which furnishes flooded lubrication to all gears and bearings inside the column and feed-box. As may be seen in Fig. 1, this pump is located on the left-hand side of the column directly above the filler cap and sight-level gage. To remove this pump from the machine, it is only necessary to take four screws out of the cover plate, the pump being integral with this plate. The intake and outlet passages for the oil are drilled into the cover plate from either end. When the plate is removed, the pump comes out with it, and is totally disconnected without having to break a single pipe joint. Practically the entire machine is automatically lubricated, from three filling stations.

The second pump is located on the right-hand side of the column, at the rear of the reservoir marked "cutting compound" in Fig. 2. This pump delivers coolant to the cutters, and is driven by a vertical shaft coming from the feed-box. It may be made totally inoperative in milling cast iron or other metals that do not require coolant for the cutters. The intake and outlet connections for this pump are similar to those of the lubricant pump, and this pump may also be disconnected and removed from the column without breaking any pipe joints. Eight gallons of coolant are delivered per minute to cutters through a 1-inch pipe at a low pressure. Ample facilities are provided on the table for returning the cutter coolant through six oil screens. The table has a working surface of 19 by 76 inches, and is machined all over on both the top and bottom.

Duplicate table, cross, and vertical feed control levers are located at the front of the knee and at the rear of the table on the left-hand side. This is a convenience in milling large work, as it enables the operator to stand in back of the table in clear view of the milling cutters, and still control the machine. Duplicate control levers are also provided for starting and stopping the machine, these levers engaging and disengaging the main-drive multiple-disk friction clutch.

Eighteen changes of feed, ranging from 5/8 to 25 inches per minute, are obtainable in either direction through a feed-box of the sliding-gear transmission type. As may be seen in Fig. 3, this feed-box is located at the rear of the column, where it is readily accessible at all times. The feed-change levers are operated from the left-hand side of the machine from the same position in which the operator stands when

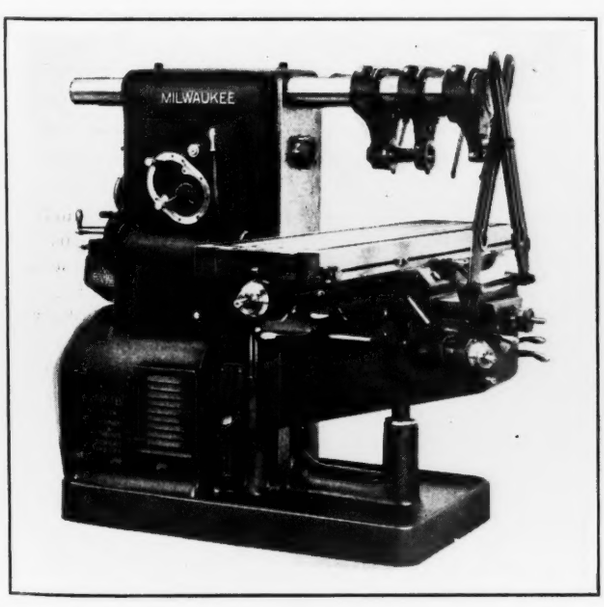


Fig. 1. Kearney & Trecker Milling Machine with Power Rapid Traverse for Table, Saddle, and Knee

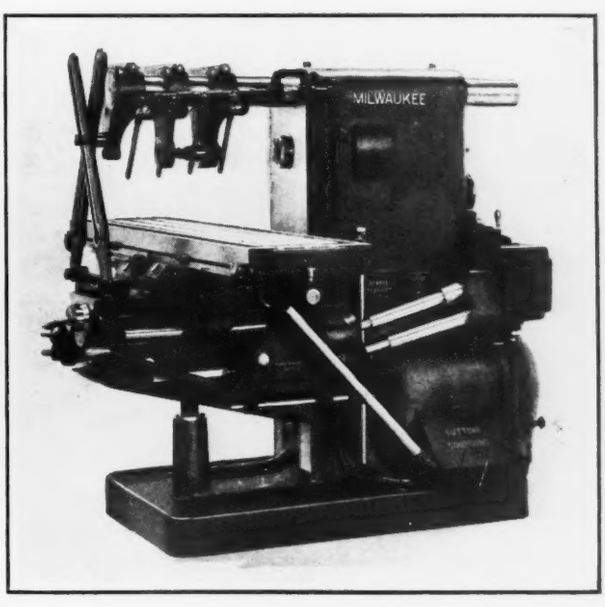


Fig. 2. Right-hand View of the Machine in which the System for supplying Compound to the Cutters may be clearly seen

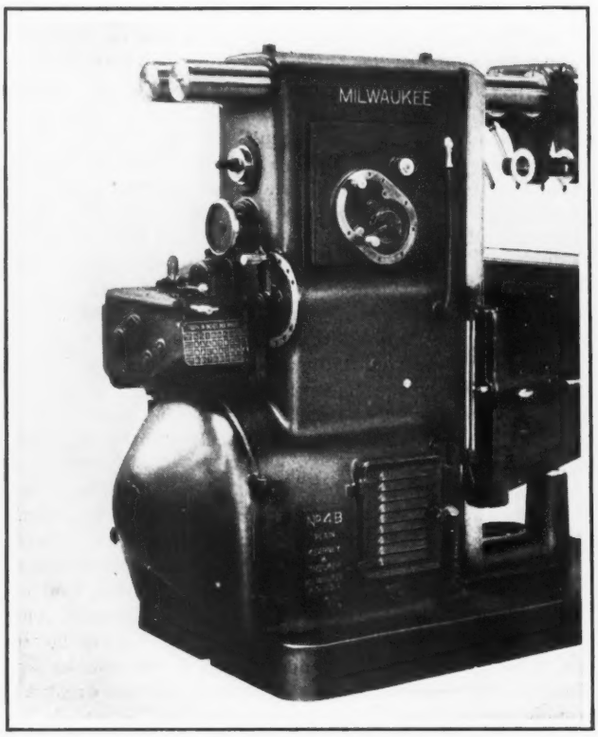


Fig. 3. Arrangement of the Feed-box at the Rear of the Column

changing speeds. A high- and low-feed attachment may be applied to the standard feed-box to provide eighteen additional feeds, or thirty-six in all, ranging from 3/16 to 40 inches per minute. A safety slip clutch is located on the rear end of the upper universal drive shaft, just in front of the universal joint. This clutch will carry any normal or heavy cut, but will slip when a positive obstruction is met with, thereby preventing any accident or breakage that might otherwise occur.

Self-oiling universal joints of the type used in this machine are illustrated in Fig. 4. The joint connection embodies a ring which consists of an inner bronze drive ring that is covered by an outer steel shell. This combined bronze and steel ring is larger in diameter than the universal joint shaft, and is said to offer a larger amount of resistance against torsion and to provide a powerful drive. Each joint fork has an oil passage drilled in it, which leads through the pin into an oil-groove on the inside of the steel ring. There are oil pockets inside the feed-box and also inside the splash lubricant chamber in the knee, which provide a "head" of oil above each end of both universal joint shafts. The oil flows down into the joint forks, and is carried by centrifugal force into the ring, thus keeping the connecting pins automatically lubricated at all times.

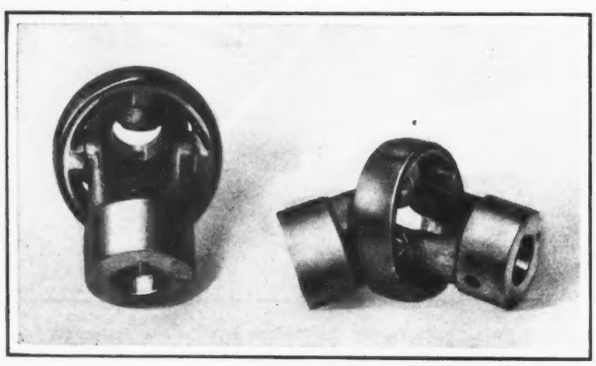


Fig. 4. Construction of the Self-oiling Universal Joints

The well-known double over-arm construction of the machines built by this company is retained in the new machine, as well as the spindle reverse, solid top knee, and protected flanged spindle nose. While the new machine is primarily designed for a motor drive, a belt drive can be furnished. The same column is used in each case, and to change from the motor to the belt drive, it is only necessary to remove the rear door of the motor compartment, and bolt a bracket sleeve and pulley in place. The change can be made at any time. For the standard motor drive, the motor is placed with its pinion toward the front of the machine. This places the motor pinion and idler gear in the main column of the machine, where they are automatically lubricated. Three models of the new machine are built—plain, universal, and vertical. The weights range from 10,800 pounds, for the plain machine, to 12,400 pounds, for the universal type.

HOEFER PISTON DRILLING, BORING AND REAMING MACHINES

Three machines recently developed by the Hoefer Mfg. Co., Inc., Freeport, Ill., for drilling, boring, and reaming the piston-pin holes of automobile pistons on a production basis, are shown in the accompanying illustrations. The machines can be used for either cast-iron or alloy pistons. The machine illustrated in Fig. 1 is a small hand-operated type; this style is particularly suitable for the jobbing and replacement fields, because of the economy with which the machine can be changed over from one size of piston to another.

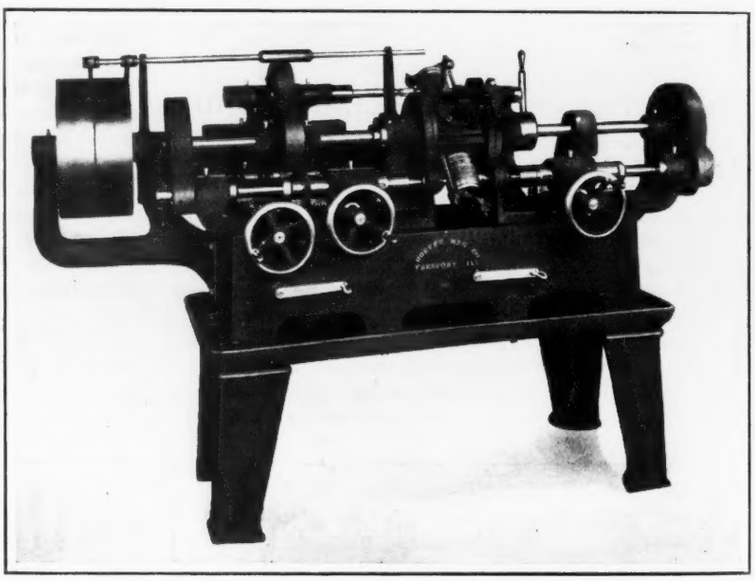


Fig. 1. Hoefer Hand-operated Machine for drilling, boring, and reaming the Piston-pin Hole of Pistons

In this machine, the piston is loaded into a four-position trunnion fixture, which locates the work from the same surfaces used in other operations. With this provision, the proper relation is obtained between the piston-pin holes and other surfaces. The holes are rough-drilled from each side through guide bushings, when the piston has been indexed into the second position. In the third position, the holes are size-bored straight through from one side with two single-point tools, so spaced that one tool finishes the cut before the second tool begins. This step corrects any error in the drilling, the boring-bar being piloted. When the piston reaches the fourth position, the holes are reamed straight through from one side by means of a reamer provided with a long pilot.

The power feed-levers are operated by hand after the various tools have been brought up to the work. The travel of the drills is short, but the boring-bar and reamer advance the entire length of the bushings before the tools start cutting

Automatic stops are provided for the tools. The production of this machine, with ordinary sizes of pistons, ranges from 60 to 75 pistons per hour. They are produced within an accuracy of 0.001 inch square.

A machine based on the same general principles as the one just described, except that the feeding is automatically obtained through a cam, is illustrated in Fig. 2. The operator only needs to trip the lever to start the machine through a cycle, and when the cycle is completed, the tools return to their starting position, at which time the feed stops. The trunnion fixture can be made to index manually as well as automatically. This machine can also perform chamfering and other operations. From 90 to 120 pistons can be drilled, bored, and reamed per hour.

The third machine, illustrated in Fig. 3, is the highest production type of the group, and differs radically in design from the other two. The main units of this machine consist of a base, trunnion, roller-bearing head, and hydraulic system. It is self-contained. Two standards on the right- and left-hand ends of the base, respectively, support the main shaft, on which the indexing trunnion is mounted at the left-hand end. This trunnion contains sixteen work-holding fixtures. On the main shaft is also mounted a direct motor-driven head equipped with roller-bearing spindles and idlers. Tools are mounted in the various spindles through Oldham couplings, which provide universal-joint drives. A constant spray of oil is distributed through the inside of the head by means of a perforated pipe to which oil is delivered by a pump.

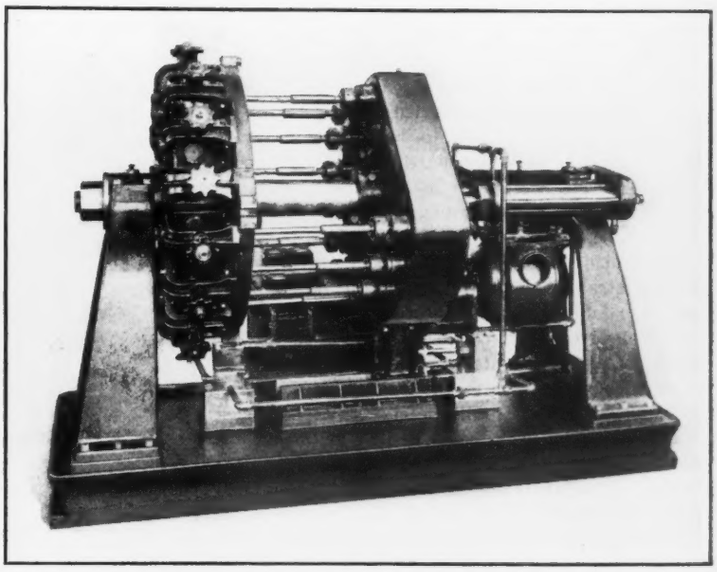


Fig. 3. High-production Type of Machine provided with a Hydraulic Feed

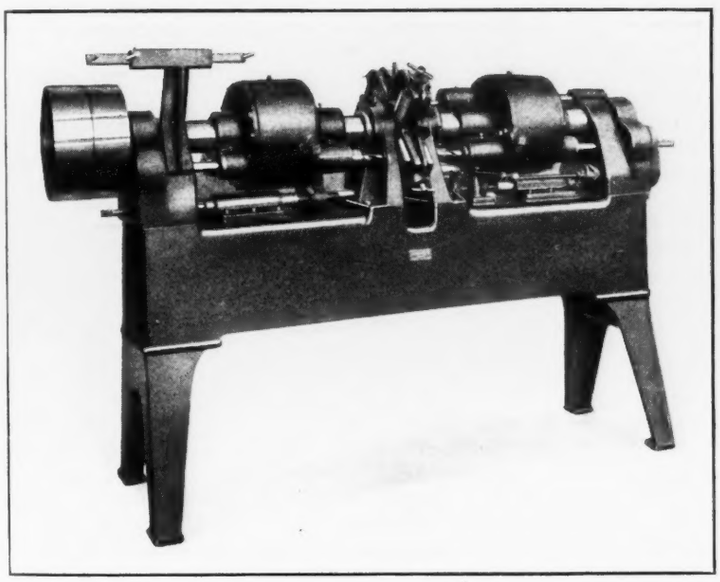


Fig. 2. Machine in which the Feed is obtained through a Cam, and which may be equipped with an Automatic Trunnion

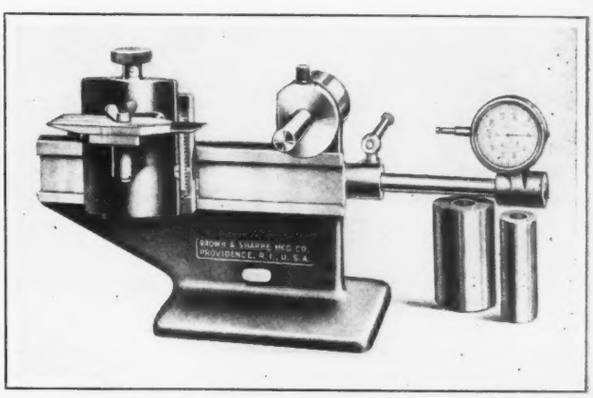
The feed of this machine is obtained by a hydraulic pump driven by an individual motor, both the pump and motor being mounted on the main base. The cylinders of this system are mounted parallel with the main shaft, just above the main driving motor, and the piston-rods are fastened directly to the main head. A hydraulic feed is particularly adapted for work of this character, due to its flexibility and ease of adjustment. At the same time, it insures safe operation, since the oil would act as a cushion to prevent any damage to the machine should a solid object accidentally interfere with the forward travel of the head.

The indexing trunnion is divided into four units, each of which holds four work-holding fixtures. Attached to the trunnion are four cams which, when the trunnion rotates, trip a pin and automatically start the working cycle. This cycle comprises first, a rapid approach; second, a cutting feed; third, a rapid reverse; and fourth, stop. Both the rate of feed and the duration of each successive movement of the cycle are easily adjusted. The main head consists of three groups of four spindles each. The first group receives the boring-bars on which either one or two tools can be mounted, depending upon the amount of metal to be removed. The second group of spindles receives four sizing reamers, while the last group receives four finishing reamers.

One of the important features of the machine is the fact that the different holding fixtures are in no way dependent upon the machine for alignment and accuracy of the operation. The fixtures are mounted on the trunnion on large centrally located bosses, and held in place by four screws each. Hardened and ground steel bushings are provided at the extreme ends of the fixtures, and all tools pilot in these two bushings. In view of the fact that the tools are driven through universal joints, they become a unit with the holding fixtures as soon as they enter the guide bushings, and so the accuracy of the work depends only upon the accuracy of each individual fixture. Another advantage of this construction lies in the fact that by merely changing the fixtures and boring-bars, any type or size of piston can be machined. Depending upon the type of fixtures used, an operator can produce from 250 to 360 pistons per hour, bored, size-reamed, and finish-reamed to an accuracy within 0.001 inch of square.

BROWN & SHARPE TESTING FIXTURE

An improved testing fixture which is convenient in sharpening gear or other formed cutters and hobs has recently



Brown & Sharpe Improved Cutter Testing Fixture

been developed by the Brown & Sharpe Mfg. Co., Providence, R. I. All sizes of cutters up to 10 inches in diameter are within the capacity of this fixture. As shown in the accompanying illustration, the testing plate is carried on a vertical slide which makes it possible to test cutters having either radial or under-cut cutting faces. The position of the testing plate is indicated accurately by means of a scale graduated in fiftieths of an inch.

One end of the testing plate is flat to facilitate testing straight-gashed cutters and hobs, while the other end is made in the form of a knife-edge to enable spiral-formed cutters or hobs having spiral gashes to be tested. The dial indicator may be furnished to read to thousandths of an inch or hundredths of a millimeter. Five hardened and ground bushings are furnished in the following diameters: 7/8, 1, 1 1/4, 1 1/2, and 1 3/4 inches. A collar is also provided for use in testing thin cutters.

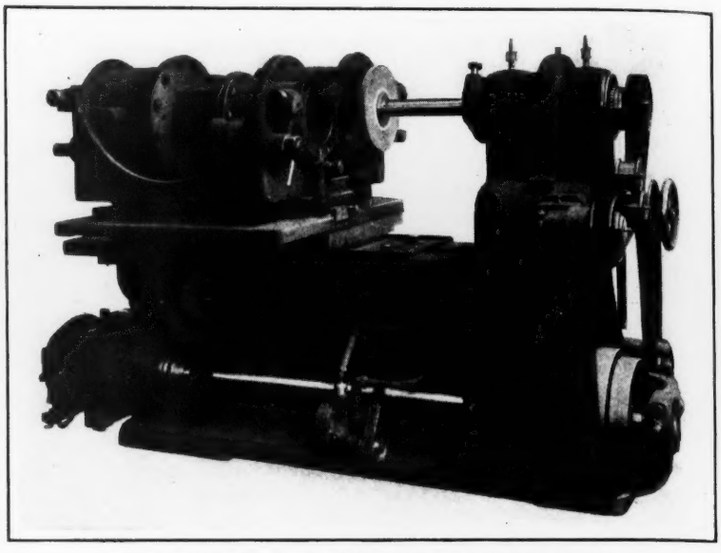


Fig. 2 Rear View of the Grinding Machine illustrated in Fig. 1

HEALD GRINDING MACHINE FOR LOCOMOTIVE AIR PUMPS

A machine designed for grinding, without disassembling, the cylinders of cross-compound air pumps in line with each other, as well as in line with the stuffing-boxes, has recently been developed by the Heald Machine Co., Worcester, Mass. This machine consists of the standard No. 50 cylinder grinding machine described in July, 1922, MACHINERY, which has been made heavier, with an extended base, and equipped with a special swivel fixture. In placing an air pump in the fixture, the pump is located from a chamfer at the end of each bore, and this insures the regrinding of bores to their original parallelism and in alignment with each other and with the stuffing-boxes. The casting is so centralized in the fixture that each set of holes is equidistant from the center line of the machine and an equal amount of stock is removed from both sets of holes. This provision equalizes any error in parallelism, facilitates grinding, and prolongs the life of the cylinders before rebushing is necessary.

In operation, one large bore or low-pressure cylinder is ground first, after which the fixture is indexed 180 degrees and the other large bore is ground. The cross-slide is then operated the correct amount to bring one small bore into line with the grinding wheel, after which the wheel is changed and this bore is ground. Next, the casting is again indexed 180 degrees and the second small bore ground. By this method, only one change of wheels is necessary per operation.

The lower part of the fixture consists of a cross-slide unit which is mounted on the table of the machine. The cross movement is obtained through a feed-screw provided with a dial graduated to thousandths of an inch. Stops are provided for readily positioning the cylinder bores relative to the grinding path of the wheels. The sliding member is arranged with a worm and worm-wheel by means of which the cradle unit can be swiveled in a horizontal plane. Stops on the cradle and upper slide accurately control the amount of swivel. The machine is arranged with a 15-inch arm, which is suitable for the average run of air-pump cylinders.

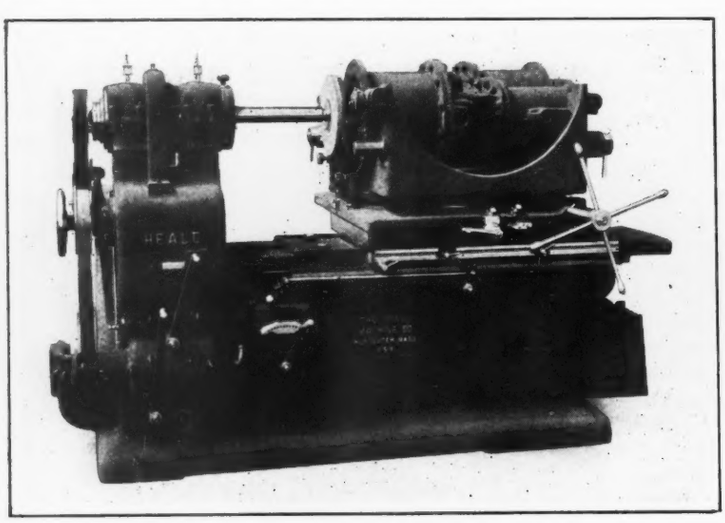


Fig. 1. Heald Grinding Machine arranged for grinding the Cylinders of Cross-compound Locomotive Air Pumps

Preparatory to loading an air pump into the fixture, aligning bars are placed through each set of cylinder bores. On each of these bars there is a taper plug which has a sliding fit on the end of the bar that carries a nut. Care must be taken to see that the nuts are at the outer end of the cylinders when the pump is placed in the machine. Next, another set of taper plugs is assembled at the opposite end of the aligning bars, which now extend through the cylinder bores, and C-washers are mounted outside of these plugs. Finally, the nuts on the other end of the aligning bars are tightened to clamp the taper plugs solidly in the chamfered surfaces at the outside ends of each set of bores.

The air pump, with the taper plugs and aligning bars assembled, is then dropped into the cradle of the fixture by the use of a crane or similar equipment. It is located endwise by pins *A* (Fig. 3) in the base of the cradle opposite each of the outer flanges of the large bores. These pins have flats on different sides, which vary in the distance from the center of the pins, this design providing for slightly different lengths of air pumps. Directly under the outer flanges of all four bores are spring-actuated plungers *B* on which the outer flanges rest as the air pump is lowered in the cradle. The springs under the plungers are compressed until the ends *H* and *J* of the aligning bars come in contact with hardened plates *C*; this positioning of the aligning bars places the cylinder bores in a parallel horizontal plane accurate with the original boring and the stuffing-box holes.

Between the ends of the aligning bars at each end of the fixture are equalizing members *D* which have hardened beveled cam pieces that come in contact with the projecting ends of the aligning bars. These equalizers fulcrum at the center, and may be operated by a handle so that the operator, by rotating the equalizer, brings the cylinder bores into accurate longitudinal alignment with the machine. Plungers *B* are then locked in fixed positions, and four screws *E* are tightened to clamp the air pump in a fixed position. With the pump thus clamped, the horizontal locating arms *F* are lowered and moved away from the ends of the aligning bars by rotating the flat surface on

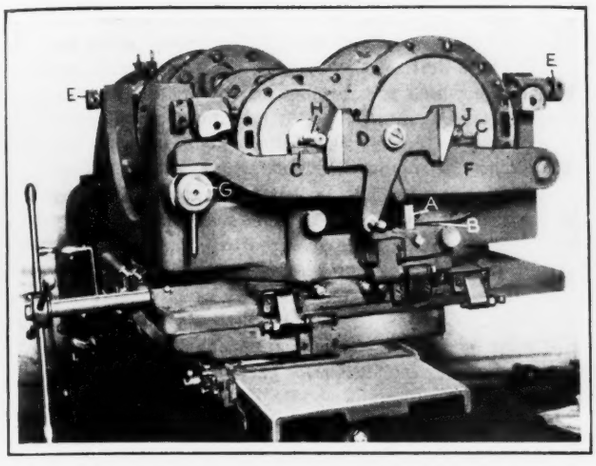


Fig. 3. Special Swivel Fixture provided for holding Air Pumps while grinding the Bores

cam-roll *G* into the uppermost position. The locating arms are then withdrawn from the cradle. By loosening the collar nuts on the outer end of the aligning bars, the C-washers may be withdrawn from the opposite end, and the aligning bars and taper plugs removed from the cylinders.

In addition to the grinding of pump cylinders, this machine is suitable for general repair work, such as triple valves, motion parts, cylinders, etc. It is necessary, however, to remove the swivel fixture and the special cross-slide and substitute the standard cross-slide. The weight of the machine illustrated, without the work, is over 9000 pounds. It is driven by a 7 1/2-horsepower motor running at 850 revolutions per minute, the motor being direct-connected to the driving shaft to give a self-contained unit particularly suitable for railroad shops.

ROCKFORD UNIVERSAL OPEN-SIDE SHAPER

The experience of the Rockford Machine Tool Co., 2400 Kishwaukee Road, Rockford, Ill., in designing and operating both planers and crank shapers, has been that there are many jobs that can be handled more advantageously on an open-side shaper than on either a planer or a standard shaper. It was the recognition of this fact that led the company to develop the universal open-side shaper here illustrated. This machine is built in two sizes, with maximum strokes of 26 and 36 inches, respectively. The shaper is equipped with ball bearings throughout, and incorporates some of the features of standard planers and shapers built by the same company. Various points of similarity will be touched upon in this description.

The machine may be equipped for either a single-pulley or an individual motor drive. For convenience in obtaining a motor drive at any time, a pad is planed on the column to receive the motor. Thus it is merely necessary to drill and tap holes for motor bolts and to substitute direct-connected gearing for the pulley. The machine is started and stopped by means of a friction clutch controlled through a lever that extends forward within easy reach of the operator. This lever is also connected to a brake in such a manner that when the clutch is released, the brake is engaged and thus instantly stops the table traverse.

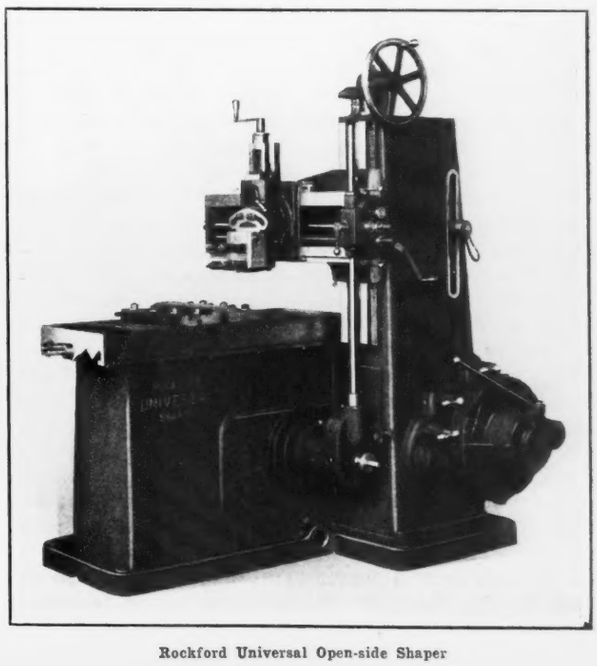
The same form of rocker-arm mechanism employed in standard Rockford crank shapers has been incorporated in this open-side machine. Sliding gears within the column provide eight different strokes of the table per minute. On the 26-inch machine there is a range of from 9 to 50 strokes per minute, and on the 36-inch machine, from 6 1/2 to 33 strokes per minute. The sliding gears are controlled through three handles, which may be seen near the housing that contains the clutch and driving gear. Only one pair of gears to suit the desired table speed is in operation at any one time.

In general, the design of the 36-inch machine follows that of the 26-inch size, except that the former can be equipped with a side-head. However, there is one other noteworthy point of difference; in order to obtain the desired throw for the crank to give a 36-inch stroke of the table, it would be necessary to have the rocker arm of such length that the table would be inconveniently high, or else the lower end of the rocker arm would have to extend beneath the base of the machine. The latter condition would necessitate having a pit beneath the machine or a hole through the floor.

To eliminate these two undesirable conditions, a patented construction has been adopted, which embodies two opposed racks. One of these racks is secured to the under side of the table, and the other is fixed in the bed of the machine. Between the racks and meshing with both of them, there is a pinion carried on a shaft connected with the rocker arm by means of a link. As the rocker arm oscillates back and forth, this link imparts a reciprocating motion to the pinion shaft, and causes the pinion to rotate. Since one of the racks is fixed, this rotary movement of the pinion imparts to the other rack and to the table, a movement double that which would be secured through a direct connection of the rocker arm link with the table. The mechanism is also a means of stepping up the power.

On both machines, there is the same provision for positioning the stroke so that it will be most convenient for the work. This is accomplished by means of an adjusting screw at one end of the table. Provision is made for efficient lubrication of the table vee bearings by means of a perforated oil-tube which runs through the table over each bearing. Felt wipers are inserted in slots opposite the openings in the oil-tubes, and as a result, a supply of lubricant runs through the felt wipers, which distribute it over the bearings. As the table is moved back and forth, the surplus oil runs down through holes at the end of the vees and drains into the reservoir in the base of the machine. Oil-cups show at a glance whether there is an adequate supply of oil to insure satisfactory working conditions.

The feed mechanism is that employed on the standard Rockford crank shapers. It consists of a ratchet and pawl mechanism, connected to the feed-screw and arranged in such a manner that the pawl can be set to "pick" any desired number of teeth on the ratchet to give the required feed movement per stroke. Eleven horizontal and vertical power feeds ranging from 0.008 to 0.088 inch per stroke are available on each machine. At the inner end of the cross-rail there are three small levers, one at the top, one at the bottom, and one at the front. The top lever provides for engaging the vertical feed, and after this engagement has been accomplished, the lever at the front is thrown one way or the other to feed up or down. Similarly, the lower lever is manipu-



Rockford Universal Open-side Shaper

lated to engage the horizontal feed, and the lever at the front of the rail is employed to obtain a feed movement either from left to right or from right to left. The ends on the horizontal feed-screw and the vertical feed-rod are squared to permit the application of a crank for obtaining the movements of these members by hand. Vertical adjustment of the cross-rail on the column is accomplished by hand only, through the large handwheel at the top of the column.

To give the necessary rigidity to the cross-rail, the rail is made of a box cross-section and has a bearing on the column three times as long as the width. After positioning the rail, it is clamped to the column by tightening bolts at the top and bottom of the rail. A binder is then tightened to secure the rear bearing to the column. The weight of the 26-inch machine without the motor is about 5000 pounds, and of the 36-inch machine without the motor, about 7200 pounds.

NILES-BEMENT-POND RAILROAD SHOP MACHINES

Three machines recently brought out by the Niles-Bement-Pond Co., 111 Broadway, New York City, for use in railroad shops, include a 90-inch wheel quartering machine, a 90-inch journal turning lathe, and a 48-inch car-wheel borer. The quartering machine, which is illustrated in Figs. 1 and 2, is regularly arranged for boring simultaneously the crankpin holes in locomotive driving wheels. By the use of a crankpin turning attachment, crankpins mounted in the wheel sets can also be turned.

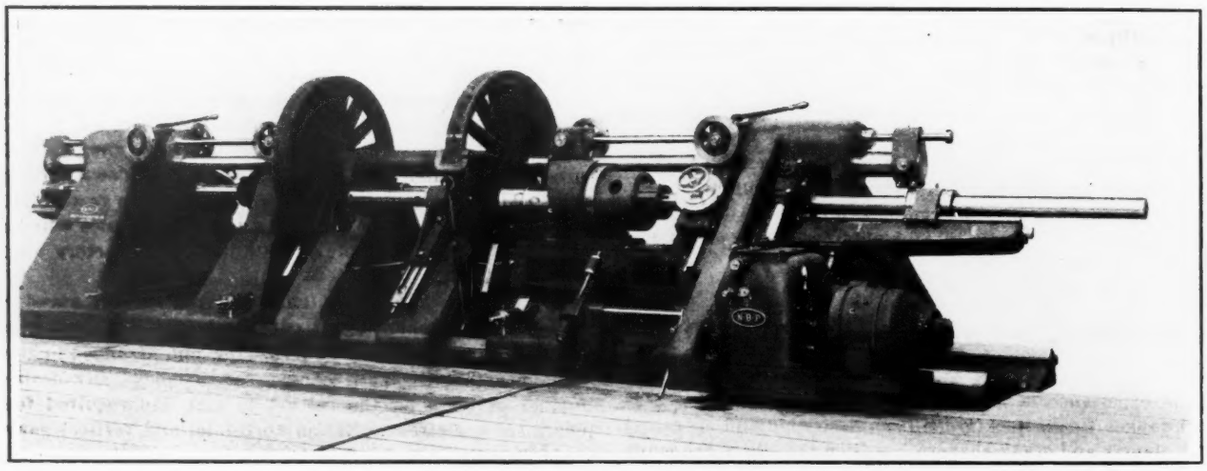


Fig. 1. Niles-Bement-Pond Quartering and Crankpin Turning Machine

The design accommodates wheel sets having a right-hand lead only, and because of this, the machine can be built with greater rigidity. The headstocks are adjustable along the bed by power, and are clamped in position, both at the front and back, by an eccentric device actuated by a wrench. The wheel sets are carried on centers contained in large sliding spindles, which are adjusted through screws that are operated by handwheels conveniently located on each side of the heads. The spindles are clamped at the front by means of levers. The headstocks are designed to carry the quartering saddle within the main casting. The guiding surfaces for the spindle saddles are so planed that the included angle between the two spindles is 90 degrees.

Each spindle saddle has an adjustment toward and away from the dead spindle center of from 11 to 20 inches to correspond with piston strokes of from 22 to 40 inches. Adjustment is made by hand, and scales which give the position of the boring-bar in relation to the dead center or axle center are provided to facilitate the setting to a predetermined stroke. Each boring-bar is provided with a hand and power traverse laterally, and is supported on the outer end of the saddle, being kept in alignment with the saddle by an outboard bearing which also carries a nut for the feed-screw. To prevent over-travel of the bars when feeding or traversing in either direction, adjustable limit switches automatically shut off power from the driving motor when the bars reach the safe limit of their travel. The feed mechanism for each spindle which is contained in the saddle, provides two feeds, and is so arranged that it is impossible to operate the fast traverse to the bar while the feed is engaged, and vice versa. The feeds and the fast traverse can be reversed through a lever conveniently located on top of the speed-box.

The wheel set is supported from each journal by two compensating V-blocks, which are free to slide on an elevating member, the lower end of which is threaded so that it can be raised or lowered to take care of variations in the size of journals. The supporting bracket also carries an outboard bearing for the boring-bar, scales being provided to facilitate setting the outboard bearing to correspond with the setting of the spindle saddle.

The support brackets are adjusted laterally on the bed by screws operated through a large handwheel. A wing is provided on each bracket to which the wheels are clamped in position for quartering. To bring the wheels into the proper location for the operation, an adjustable link is provided on each head. One end of this link is fastened to a C-clamp applied to the tire or rim of the wheel center, as shown, while the other is fastened to an eye-bolt in the bed. Each boring spindle is driven independently by its own motor through worm-gearing.

When the machine is to be driven by direct current, it is equipped with two shunt-wound five-horsepower, 2-to-1 variable-speed motors, having a speed range of from 650 to 1300 revolutions per minute. In conjunction with the two mechanical speeds in the gear-box, the boring-bar speeds obtainable range from 5.7 to 23.8 revolutions per minute. For alternating current, the machine is equipped with two five-horsepower squirrel-cage induction motors having a speed of 1150 revolutions per minute. The two spindle speeds obtainable in this case are 10 and 21 revolutions per minute.

Double crankpin turning attachments of the box-tool type seen in Fig. 2, which permit turning two pins simultaneously, can be furnished. Each attachment consists of a heavy base, fitted to the V-ways of the bed and bolted to a planed pad on the headstock. A sliding bracket which carries and guides the turning head is bolted at one end to the saddle, and supported at the other end by a bearing on the base. This sliding member is adjustable up and down on the base in unison with the saddle to provide for various crank throws. Scales facilitate this setting, and when the desired setting has been obtained, the bracket is locked to the base. The sliding spindle in the headstock is equipped with an extended center of large diameter that is guided at the outer end by an outboard bearing. On top of this bearing is an additional handwheel which is connected with the screw of the spindle, so that centers may be extended or withdrawn either from the setting up position at the wheels or from the operating position at the heads.

In setting up for crankpin turning, it is necessary to relocate each boring-bar through the sleeve of the outboard bearing on the saddle in relation to its position for quartering. Properly spaced taper pin holes in the bar, which correspond with taper holes in the sleeve, permit this relocating to be readily accomplished. Wheels may be quartered without removing the crankpin attachment, the end of the boring-bars being arranged to receive an auxiliary bar, the outer end of which is supported in an adjustable bearing on the wheel support. Crankpins up to 12 inches in diameter and 24 inches in length can be turned. The swing over the bed is 99 7/8 inches.

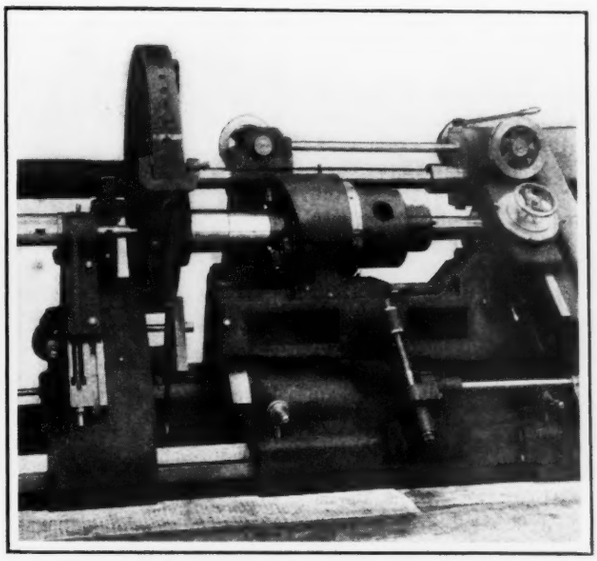


Fig. 2. Close-up View of the Crankpin Turning Attachment

The locomotive journal turning machine, which is illustrated in Fig. 3, may be furnished for inside journal turning only; inside and outside journal turning only; journal turning and single or double quartering; and with or without crankpin turning attachments. Power is transmitted from the driving motor on the headstock through a belt to a jack-shaft and reduction gearing at the back of the headstock. From a pulley on the jack-shaft, a second belt runs directly around the faceplate, having a contact with the faceplate for over 180 degrees of its circumference. A tightener pulley is held in engagement with the belt by means of a compression spring. The motor is also mounted on rails to permit tightening the belt running from the motor to the jack-shaft. Both belts are covered by sheet-iron guards.

A hand-brake controlled by a lever located on the front of the headstock acts directly on the rim of the faceplate to stop it in the most convenient position for putting in or taking out the wheel sets. The driver has an adjustable member which projects between the spokes of the driving wheel and is clamped around a spoke. This driver is adjustable radially to suit different sizes of wheels. Both ends of the axle are carried on non-rotating or dead centers.

The heavy counterweights on driving wheels exert considerable centrifugal force when revolving in a lathe, and it was therefore necessary to develop an efficient method of counterbalancing them. This is accomplished by means of a counterweight arranged entirely within the faceplate, as shown in the phantom view, Fig. 4. The counterweight may be conveniently adjusted to suit different sizes of wheels by simply turning a wrench, a pointer showing the position of the counterweight.

The headstock and tailstock are both provided with a power traverse along the bed, which is obtained by means of a separate five-horsepower motor. Eccentric clamping mechanisms which operate at both the front and back of each member provide for quickly clamping the headstock and tailstock to the bed. The carriage consists of two compound tool-rests, which are mounted on a base bolted to the bed between the driving wheels. Each tool-rest is equipped with a holder, so constructed that the tools may be set at an angle. There is a power longitudinal feed to the rests for turning journals, and a power cross-feed for facing hub liners. Feed changes are obtained through a gear-box located on the headstock, and the feeds are reversible. A hand adjustment is also provided for both the longitudinal and cross movements of the tool-rests. The rests may be equipped with burnishing rollers.

An outside rest for turning the journals of trailer sets can also be furnished. This rest is equipped with a pneumatic withdrawing mechanism, so that it can be quickly lowered when not in use. For direct current, the machine is equipped with a 15-horsepower motor having a speed variation of 3 to 1, while a 15-horsepower constant-speed motor is provided for alternating current.

For shops where the number of wheel sets handled is not sufficient to warrant the installation of a quartering machine, this journal turning lathe may be equipped with quartering and crankpin turning attachments. These attachments can be furnished for either single or double quartering, and with or without single or double crankpin turning attachments. Attachments for double-quartering can be provided for a left-hand lead as well as a right-hand lead. Wheel supports are furnished for use in quartering or crankpin turning. The swing over the bed of this machine is 90

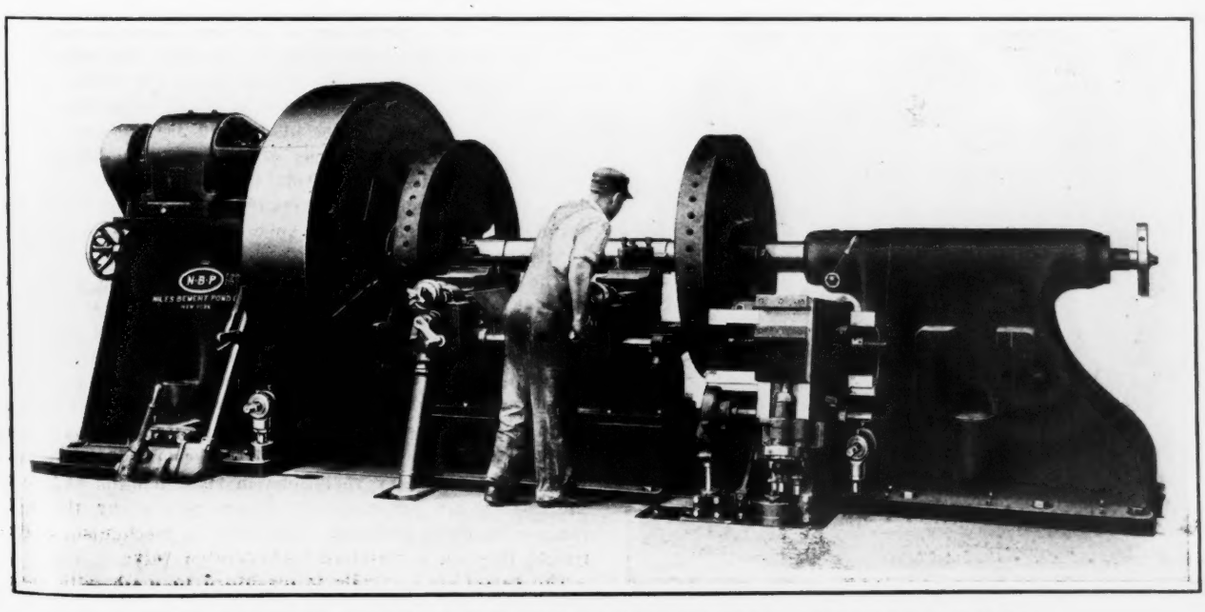


Fig. 3. Locomotive Journal Turning Lathe which may also be equipped for quartering and crankpin-turning

inches; the maximum distance between the faceplate and the tailstock center, 12 feet; and the maximum distance between centers, 13 feet.

Fig. 5 shows the latest 48-inch car-wheel borer built by this company. It is equipped with an automatic chuck, quick-traverse crane of either the pneumatic or drum type, and a convenient control. Four feeds are available through a single lever. Another feature is a power traverse to the boring-bar which may be furnished for installations where a large quantity of wheels are to be bored. Taper bushings are provided for both the boring-bar and the table spindle to maintain alignment between these parts and insure accurate boring of the work.

The wheel is locked automatically in the self-centering chuck as the operator starts the machine. Conversely, when the table is stopped and reversed at the completion of an operation, the wheel is automatically loosened. The chuck has five hardened steel jaws, which are adjustable on serrated slides fitted in radial slots. As a convenience in setting the jaws to suit the diameter of the wheels to be turned, the table is scribed with circles that are stamped from 26 to 43 inches. The length of time required to clamp or unclamp the chuck is only that which is consumed as the table gear moves through an arc of 45 degrees.

The crane for handling the wheels is located conveniently on the right-hand side of the machine, where it does not require extra head room. In the illustration a pneumatic crane is shown; this crane can be controlled from the front of the machine, where the operator is near the wheel. The drum type of crane is driven by a separate five-horsepower motor, and is controlled through friction clutches operated by means of a conveniently located handle. The long reach of the crane permits it to be swung over two wheel supports, so that a finished wheel may be lowered at one point while the next wheel to be bored is ready to be picked up from the other support.

The traversing of the boring-bar has been simplified by the introduction of a compound gear reduction, which permits spinning the large handwheel around with little effort. The boring-bar has a travel of 39 inches, which is ample for wheels having the maximum A. R. A. standard length of hub. When the rapid traverse is furnished, it is actuated through a push-button switch. The counterweight for the bar runs on rollers on an inclined way at the back of the frame. The guides are so designed that should the cable break, the counterweight cannot fall off the machine and cause an accident. The machine can be equipped with a hub facing attachment, when so ordered.

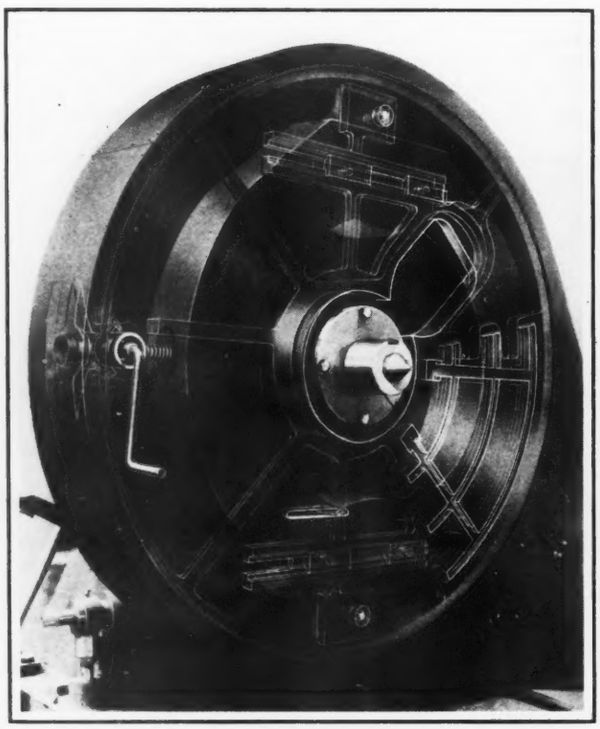


Fig. 4. Phantom View, showing Counterbalance Inside of Faceplate

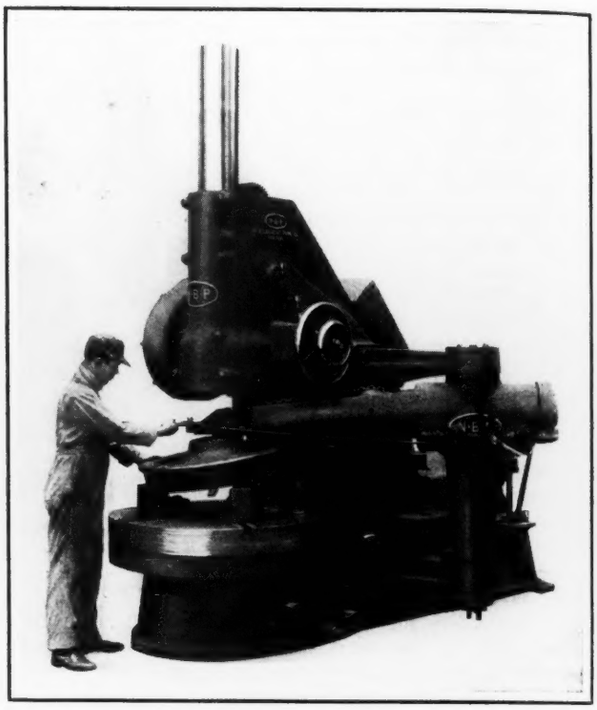


Fig. 5. Car-wheel Borer provided with a Pneumatic Crane for handling the Wheels

For machines having an alternating-current motor or a belt drive, the table can be furnished with a brake that is controlled through a foot-lever. On direct-current motor-driven machines, the table is stopped by dynamic braking the instant that the stop-button is pushed.

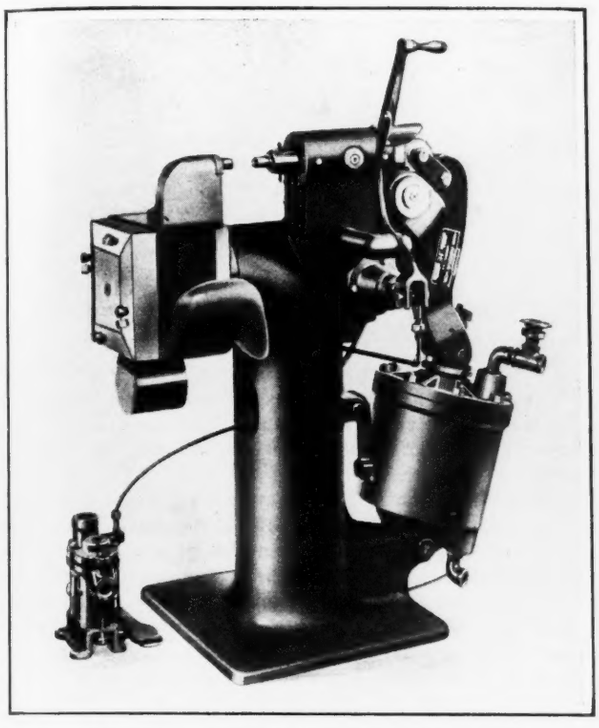
HANNA TURRET RIVETER

One unit of a new line of riveters now supplied to the automotive industry by the Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill., for riveting automobile chassis frames complete, is here illustrated. Each unit of this new line is designed specifically for a certain class of riveting found in nearly all chassis frames. The rivets are driven cold.

The principal feature of the riveter illustrated is a rotating turret-head on which four horns or noses are mounted. Any one of these noses may be indexed to bring a stationary rivet die into alignment with the movable die mounted on the plunger or ram. The noses enter the inside of the chassis frame, and must conform in shape to the open space inside of the frame adjacent to and behind the various rivets. Clearance conditions are often quite different for driving different rivets. From the standpoint of the number of nose clearance conditions that may be met, this turret riveter is equivalent to four yoke riveters or presses of like reach, gap, and tonnage.

The riveting or pressure-exerting mechanism is of the standard Hanna "Rapid" type. The die travel is rapid as the die approaches the work, and then the speed gradually decreases until the die enters the uniform pressure area of the stroke. An advantage of this stroke is that the speed is greatest where the work is lightest. As the rivet head is formed, the pressure increases until it reaches a maximum, and this maximum is maintained for several inches of piston travel. Ordinary variations in rivet lengths and plate thicknesses are automatically taken care of by the wide range of uniform pressure. The riveting mechanism is controlled through a standard foot-operated valve.

The turret-head spindle is machined to mesh with interrupted thrust grooves in the wall of the barrel in which it



Hanna Turret Riveter for Automobile Chassis Frames

rotates. This gives a breech-lock construction that resists the riveting thrust tending to pull the turret spindle out of the barrel. The turret-head is locked in the index positions by means of a pin, which selectively engages four holes spaced around the turret spindle. The index-pin is air-actuated in both directions, but the air cylinder is supplemented by a hand-lever. The spindle is rotated through a hand-crank, which is also coupled to the valve of the index-pin air cylinder, so that a longitudinal crank movement relative to the turret spindle pulls the index-pin out of the spindle, while a reverse movement forces the pin out of the spindle.

To index the turret from one position to another, the operator pulls the end of the hand-crank about 3 inches forward to pull out the pin, and then rotates the crank 90 degrees about the spindle axis to bring the turret into the next position. Releasing the crank allows it to move back into the neutral position, and this results in the index-pin being forced into the spindle and held there. When the crank is moved further back, it is released partially from the turret spindle, and may be rotated independently of this member. Therefore, though the crank is limited to a rotation of 90 degrees, it is effective in revolving the turret through 360 degrees.

The riveter may be provided with a swivel base so that it may be swiveled in the operation to eliminate the necessity of swinging the work. The equipment may be operated as fast as 50 cycles per minute. It occupies a floor space of 30 by 40 inches, and is 45 inches high.

GOULD & EBERHARDT SHAPERS

A number of important improvements have been made in the line of shapers manufactured by Gould & Eberhardt, Newark, (Irvington) N. J. All the characteristic features of these shapers have been retained, and the outward appearance of the machines has not been greatly changed. There is an automatic forced-feed lubricating system, which includes the ram bearings as well as the bearings of all other power-reciprocated slides or driven shafts. The oil-pump is driven at a constant speed, and the oil is conducted to all bearings through tubes. Pins or shafts are drilled and cross-drilled for lubricant when necessary. All outlets lead into oil-grooves designed to distribute the lubricant to the best advantage, and in all cases provision is made for draining and returning used oil.

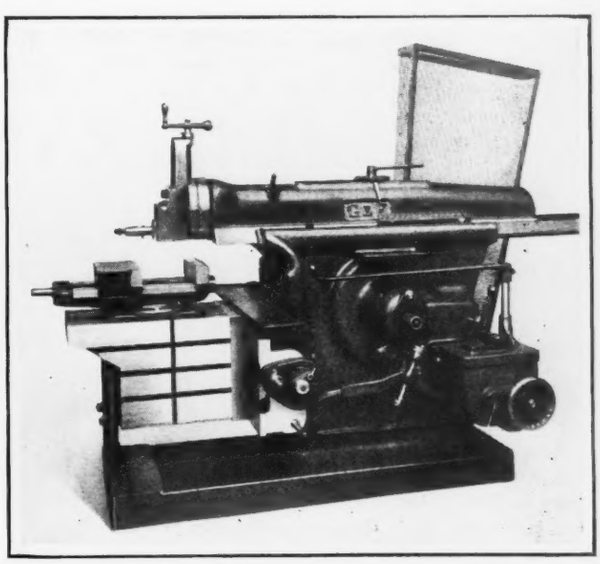
The system is designed to flood every bearing surface continuously, at the minimum pressure, but a by-pass valve is provided which may be closed to increase the oil pressure, if desired. The oil is directed down over the moving parts inside the shaper frame, and flows through a screen to a sump in the base, whence it passes to the pump through a filter. Drainage canals and wipers are provided, so that oil cannot run down the outside of the machine. New oil is supplied and the level observed through an opening in the base. Special attention has been paid to the lubrication of the ram bearings, in order to provide ample lubrication for all lengths and positions of ram stroke. On the operator's side of the machine is a "sight-feed" or window through which the oil may be observed as it is forced to the ram bearings.

Power is transmitted through a disk clutch mounted on Timken roller bearings and acting upon a six-splined shaft. A feature of this clutch is the ease with which it may be adjusted. One clutch member carries a spring pin, and another has a series of holes to receive this pin. To adjust the clutch, the pin is withdrawn from the hole in which it is inserted, and the member that carries the pin is rotated to the right or left to bring the pin into another hole, as may be required, to cause the clutch to carry a lighter or a heavier load.

The table top has been extended, the T-slots are machined to permit the accurate location of jigs, fixtures, etc., and a stop-pin is provided to prevent the vise from being accidentally shoved off the table. The base has been extended, and a new support provided for the table. The support is fastened to and moves with the table, sliding upon a rail secured to the base. The support is lengthened at the bottom so as to increase its effectiveness, especially when the table is set to the extreme end of the cross-rail on either side. If the table-support rail should become worn in service, it may be easily removed and trued up without taking a cut over the base of the shaper.

Another new feature of these shapers is the provision of a guard around the ram slide, which is secured to the rear of the frame. This guard serves as a safety device to prevent operators from being injured by the ram movement, protects the bearing surfaces of the ram, and catches any oil that might work its way past the grooves on the rear end of the ram bearings.

A new plate-type vise is also provided for use with these machines. In this vise, the jaws are close to the table, and the graduations are on a large diameter and on an angular surface. It is stated that when the bolts are loosened for angular adjustment, the vise will not creep on the table.



Gould & Eberhardt "Invincible" Shaper of Improved Design

WARNER & SWASEY PNEUMATIC TOOLS

Improvements and additions have recently been made to the line of "Roto" portable tools described in February, 1925, MACHINERY, which are manufactured by the Warner & Swasey Co., Cleveland, Ohio. Some of the new tools are shown in Figs. 1 and 2. All of them are driven by an air motor of the two-cylinder type. In each cylinder a rotor revolves eccentrically. The main flow of air which enters each cylinder drives the rotor in a clockwise direction, but a part of the air also exerts a constant downward pressure on the rotor blade, to seal all direct connections between the inlet and exhaust ports.

The rotors are keyed to a shaft in directly opposed positions, so that when the rotor in one cylinder is in position for exhausting, the rotor in the other cylinder is at the midway point of its upward power impulse. This construction prevents any possibility of stopping the motor on center. There are only three moving parts in the motor—the shaft assembly and the two rotor blades. A clearance is provided between the rotors and cylinder walls that is just sufficient to prevent wear of these parts. An oil film seals this clearance, and prevents leakage of air between the rotors and walls. A large ball bearing mounted between the two cylinders centralizes the rotor assembly. There is an oil reservoir in the handle, which holds sufficiently lubricant for from six to ten hours of continuous operation. The oil enters the motor with the incoming air, and can be regulated by means of an adjustable needle valve.

The type D-1 grinder illustrated in Fig. 1 may be run at any speed up to 4000 revolutions per minute, and is intended for light grinding, buffing, and polishing operations. When fitted with rubber-bonded abrasive wheels, it is suitable for grinding welds. It is also used for grinding and smoothing die-molds, and for cutting and turning wood where accuracy is required. This grinder weighs only 8 3/4 pounds, and the average air consumption, computed on the basis of 85-pound air pressure, is about 30 cubic feet of free air per minute. The desired speed is instantly selected through a throttle control. This tool carries a grinding wheel 6 by 1 by 5/8 inch in size.

Another D-1 grinder, provided with an extension on the wheel end that is enclosed in a tubular housing, is shown at *A* in Fig. 2. This grinder is usually equipped with a cone-wheel, a cup-wheel, or a plain wheel of small diameter, and is used for grinding the inner surfaces of hollow castings that would otherwise be inaccessible. The grinding wheel measures 4 by 1 by 5/8 inch.

A third type of D-1 grinder is equipped with reduction gears to give satisfactory results on a low air pressure of from 50 to 65 pounds per square inch. The gear reduction is 2 to 1, and this considerably increases the power, so that the tool is suitable for using grinding wheels up to 8 inches in diameter. The design is well adapted for use in connection with planers, boring mills, and engine lathes, and for emergency grinding of all kinds. When used with machines, it can be easily mounted in place.

A fourth type of D-1 grinder, which is shown at *B* in Fig. 2, is provided with a right-angle head for convenience in grinding large surfaces with abrasive disks. This type is designed especially for grinding large metal surfaces like those of automobile bodies. When fitted with a long hose, a wide use of the disk-grinding method is possible in automobile assembly lines. The disk may be 8 inches in diameter or smaller, and the weight of the tool equipped with a disk is 13 pounds.

There is also a type D-3 grinder which is very similar in appearance to the D-1 style shown in Fig. 1, but is larger, heavier, and more powerful. It is designed primarily to accommodate large-size grinding wheels for continuous heavy-duty work. Grinding wheels up to 2 inches wide can be used. Under a working load, the speed is 3200 revolutions per minute, while the free speed is 4000 revolutions per minute. The weight of the tool without a grinding wheel is 16 pounds, and the over-all length, 17 1/2 inches.

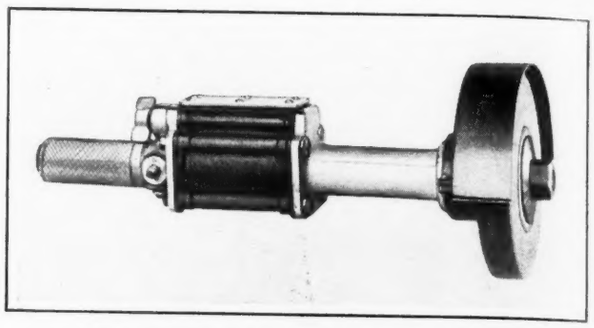


Fig. 1. Warner & Swasey "Roto" Pneumatic Grinder

At *C* in Fig. 2 there is shown a type E-3 pneumatic drill, which is light enough to handle conveniently small-size drills and reamers, but which can also be used for drilling and tapping holes up to 1/2 inch in diameter through cast iron 1 1/2 inches thick. The motor is the same as that used in the type D-1 grinders. A quick-acting reverse mechanism embodied in the control handle facilitates driving taps, setting studs, and running down nuts in assembly work. Three models of this tool are manufactured, having speeds of 500, 750, and 1500 revolutions per minute, respectively. The weight of the drill is 13 pounds.

BONNEY CHROME-VANADIUM WRENCHES

Two new lines of chrome-vanadium wrenches have been brought out by the Bonney Forge & Tool Works, Allentown, Pa., for millwrights and loom fixers. The millwright's line consists of S-wrenches, which are made light, thin, and strong. The loom fixer's wrenches are of a design particularly suited for use in textile mills. They are short and stocky.

FOSTER UNIVERSAL TURRET LATHE

An improved 1-B universal turret lathe is being placed on the market by the Foster Machine Co., Elkhart, Ind. The improvements consist of a split-ring type of binder for the hexagon turret; a power rapid-traverse unit for the turret-slide; a longer bed to permit greater longitudinal feeding movements of the carriage and turret-slide; and an increased swing over the ways and cross-slide to give greater chucking capacity. The turret binder grips on a large diameter almost entirely around the turret, and the same lever employed in operating the binder releases the lock-bolt. The power rapid-traverse unit is mounted on the rear of the saddle, and is controlled by a lever within easy reach of the operator. The

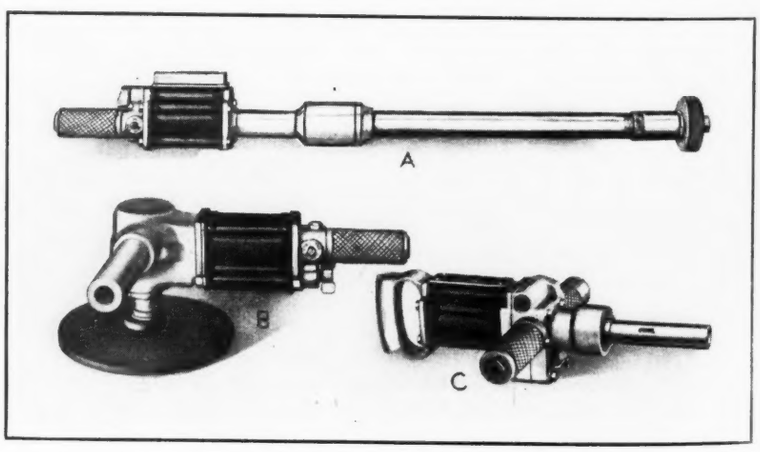


Fig. 2. Two More Types of "Roto" Grinders and One Drill

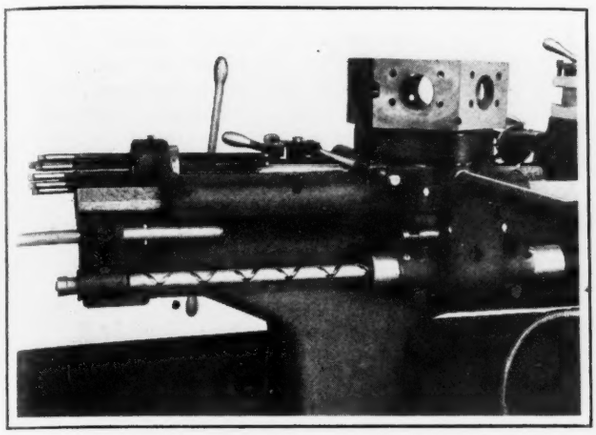


Fig. 1. Arrangement of the Power Traverse Unit on Foster Turret Lathe

return movement of the rapid-traverse unit can be automatically stopped at predetermined points. Through an interlocking mechanism, the turnstile provided for traversing the turret-slide by hand is automatically disengaged, so that it does not revolve while the rapid-traverse mechanism is in motion.

The cross-slide extends entirely across the bed, and has an effective cross travel of 10 inches. With this design, a tool mounted on the square turret can be carried past the center of the spindle. Tools may be mounted on a pad at the back of the cross-slide for operating on the rear of the work. The swing over the cross-slide is 9 1/2 inches. Twelve reversible power feeds are obtainable for the cross-slide, and twelve longitudinal feeds for the carriage, these feeds being independent of the turret saddle feeds. Six adjustable independent stops, which may be indexed, are provided for automatically stopping the longitudinal feeds of the carriage.

There are also twelve feeds for the hexagon turret. The lock-bolt of the turret is located to give the greatest support to the turret face carrying the tool in action. The turret is tapped to receive independent pipe lines to each face. Independent stop-screws are carried in a spool at the rear of the saddle, as seen in Fig. 1, and index in time with the turret faces. The stop-screws abut against a slidable stop, which is also adjustable and retained by a spring-locking key. This eliminates the necessity of lengthy adjustments of the stop-screws. The gears in the carriage and saddle aprons run in oil, and the clutches in these aprons are adjustable from the outside.

The spindle nose has a thread of large diameter, a large-diameter pilot, and a short overhang. The hole through the spindle is 2 5/8 inches in diameter. Through gear combinations effected by the movement of four levers, twelve spindle speeds are obtainable. These speeds are reversible, and range in geometrical progression from 20 to 480 revolutions per minute. The automatic chuck is of the master collet type, and has a capacity for 2-inch round stock. The final closing action of the collet is effected through a toggle action. The mechanism can be supplied for either draw-in or push-out types of collets. The bed of the machine is of the double girder type, and is cast integral with the head. The swing over the bed is 17 inches.

The drive can be either from a countershaft or direct from a motor mounted on the rear of the headstock leg or on top of the head. A five-horsepower motor running at 1200 revolutions per minute is used. A threading attachment of the leader and follower type can be supplied. With one gear shift, each leader and follower enables threads of two different pitches to be cut—one and four times the pitch of the follower, respectively. A taper attachment for use in turning tapers up to 3 inches per foot, can also be furnished.

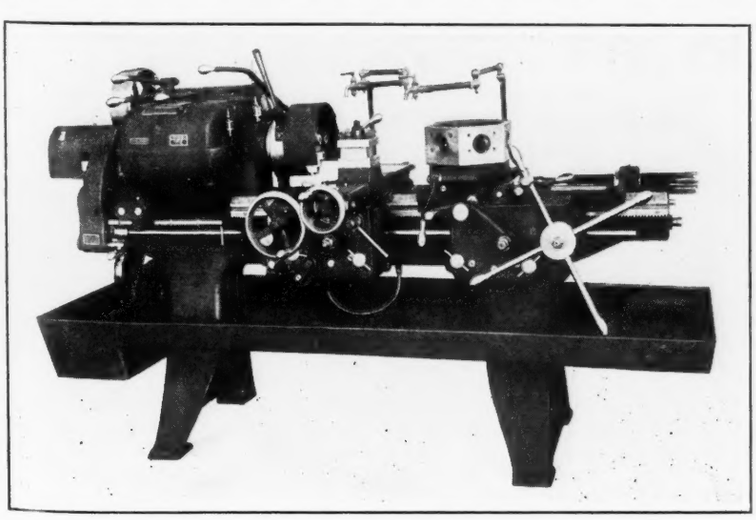


Fig. 2. Foster Improved Universal Turret Lathe

BARNES DRILL CO.'S HONING MACHINES

Hydraulically reciprocated honing machines of single- and multiple-spindle designs are being placed on the market by the Barnes Drill Co., 814 Chestnut St., Rockford, Ill., for finishing automobile, gas-engine, pump, air-brake, and other internal combustion, hydraulic, or pneumatic cylinders. Bronze and cast-iron bushings, bearings, etc., can also be finished. There is a wide difference of opinion as to the proper ratio of spindle speed to the reciprocation of the hone in honing operations, and so any desired spindle speed can be furnished. On the multiple-cylinder machine, the standard speeds range from 75 to 589 revolutions per minute, and the number of cycles of reciprocation, from 0 to 75 per minute. The hydraulic reciprocation of the hones gives an evenness and uniformity of honing over the full length of cylinders.

In the No. 214 multiple-cylinder machine illustrated in Fig. 1, there are two driving spindles which are driven by helical crown gears, the spindles running in two large reciprocating guides. On the bottom ends of these guides is attached a multiple head having from two to eight spindles, according to the requirements of the operation for which the machine is intended. Each main spindle drives one-half of the auxiliary spindles. A hydraulic cylinder which permits any vertical travel up to 16 inches is mounted between the spindle housings, and contains a piston that is attached to the auxiliary head on the center line of the spindles and midway between them. An air-cylinder counterbalance is provided, which operates directly from the main air line.

When the honing stones are 4 inches long, it will be evident that cylinders 19 inches long may be honed, allowing for an over-run of 1/2 inch at each end of the cylinders. All power shafts are mounted on radial ball bearings, and all gears have helical teeth. A forced-feed system supplies oil to all ball bearings and sliding surfaces. The clutch is of the multiple-disk type. A 20-horsepower motor running at 1200 revolutions per minute is recommended for this machine.

The No. 212 single-spindle machine is shown in Fig. 2. The hydraulic cylinder of this machine also regularly permits any verticle spindle travel up to 16 inches. It is superimposed directly over the spindle, and the piston is attached to the spindle by means of a ball-bearing coupling. This construction permits any desired spindle stroke, and assists in setting the stroke so that the hones will extend equally from the bore at each end of the stroke. Stops on a vertical rod may be adjusted for any length of stroke, and a skip stop permits of lifting the spindle to the uppermost position. The clutch lever is so arranged that when it is pulled forward, it engages the driving multiple-disk clutch and opens the hydraulic

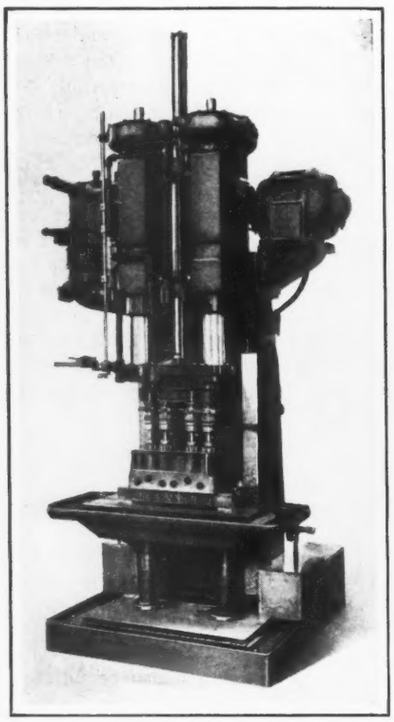


Fig. 1. Multiple-spindle Honing Machine built by the Barnes Drill Co.

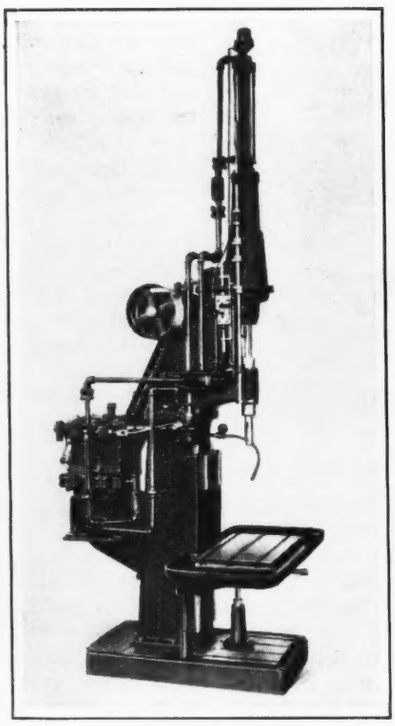


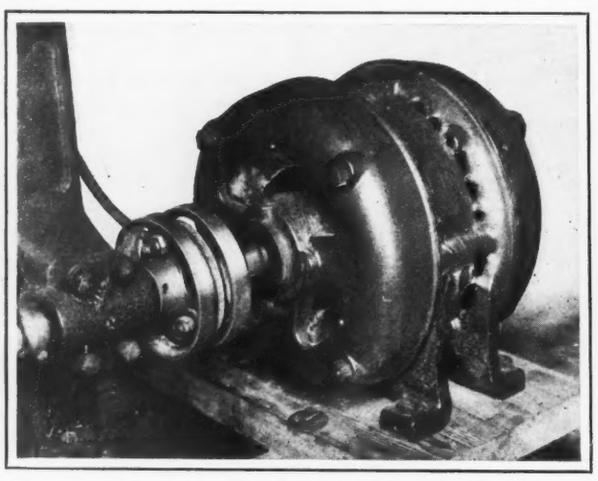
Fig. 2. Single-spindle Type of Hydraulically Reciprocated Honing Machine

valve, thus simultaneously starting rotation and reciprocation. A backward movement of the lever serves to stop the machine. Through a latch on the lever, a hand control of the vertical travel of the spindle may be obtained without engaging the clutch. Thus the spindle may be brought to the work or lifted from it without rotation. A five-horsepower motor running at 1200 revolutions per minute is recommended for this machine.

An air-operated table may be furnished when the 16 inches of vertical-spindle travel is not sufficient to permit of lifting the hone from the work. An air cylinder on this table provides for lowering the table about 9 inches. The weight of the single-spindle machine equipped with a motor and starter is about 3400 pounds, and of the multiple-cylinder machine equipped with a motor and starter, about 7840 pounds.

"FLEXOID" COUPLING

A flexible coupling recently placed on the market by the Smith Power Transmission Co., 1218 Ontario St., Cleveland, Ohio, is here illustrated in a motor drive installation. This coupling consists of two cast-iron flanges, coupled together by means of a flexible fabric disk in such a manner that there are no metal-to-metal bearing surfaces. With this construction, complete electrical insulation is insured. The resilient disk allows angular misalignment without chatter or without the transmission of vibration to the driving unit. The coupling is made in eight sizes, having capacities ranging from 2 to 100 horsepower at 1000 revolutions per minute.

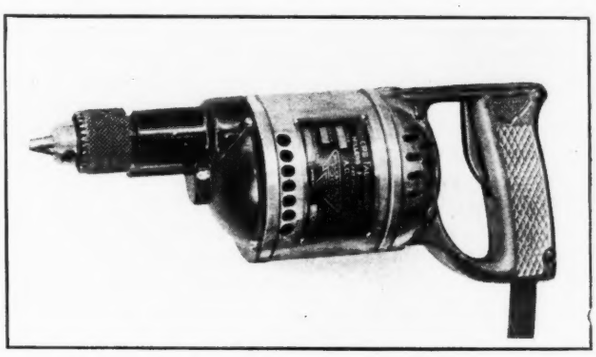


Application of a "Flexoid" Coupling in a Motor Drive

MILLERS FALLS PORTABLE ELECTRIC DRILL

The first of a new line of portable electric drills is being introduced to the trade by the Millers Falls Co., Millers Falls, Mass. This tool is a 1/4-inch size, intended for operation on either 110- or 220-volt alternating or direct current. The universal motor is of 1/8 horsepower capacity, and gives a no load speed of 1800 revolutions per minute to the chuck. A heavy-duty Jacobs chuck is provided. The armature is mounted on ball bearings, and there is a ball thrust bearing on the spindle. An automatic switch is located in the handle.

The brushes are of the pigtail type, and are easily replaced from the outside without taking the tool apart. Grease lubrication is provided for throughout. To permit boring in close quarters, the spindle is offset from the center of the drill so as to be only 13/16 inch from the outside of the housing. The drill measures 12 inches in over-all length, and weighs 5 1/2 pounds.



Millers Falls Portable Electric Drill

NATIONAL AUTOMATIC-FEED SEMI-HOT HEADING MACHINES

Two smaller sizes of automatic-feed semi-hot rivet and bolt heading machines have recently been developed by the National Machinery Co., Tiffin, Ohio, to supplement the 1-inch machine illustrated in March, 1923, MACHINERY. The 3/8-inch size is shown in Fig. 1, while the 5/8-inch size is similar in appearance to the 1-inch machine referred to.

A wide variety of single-blow work up to 3/8 inch in diameter by 4 1/2 inches in length can be handled in the 3/8-inch machine. Large rates of production are obtainable, since the machine has a speed range of from 150 to 200 revolutions per minute, and where long runs of one size are the rule, work can be made from coil stock. In the latter case, a long furnace with a small heating chamber is employed, and the stock is taken off the original coil and looped or rewound into coils of large diameter by means of the new coiler shown in Fig. 2. An electric butt welder, employed in conjunction with this coiler, joins one coil to another to make the operation continuous. In this design, single feed-rolls of large diameter are used in place of double rolls.

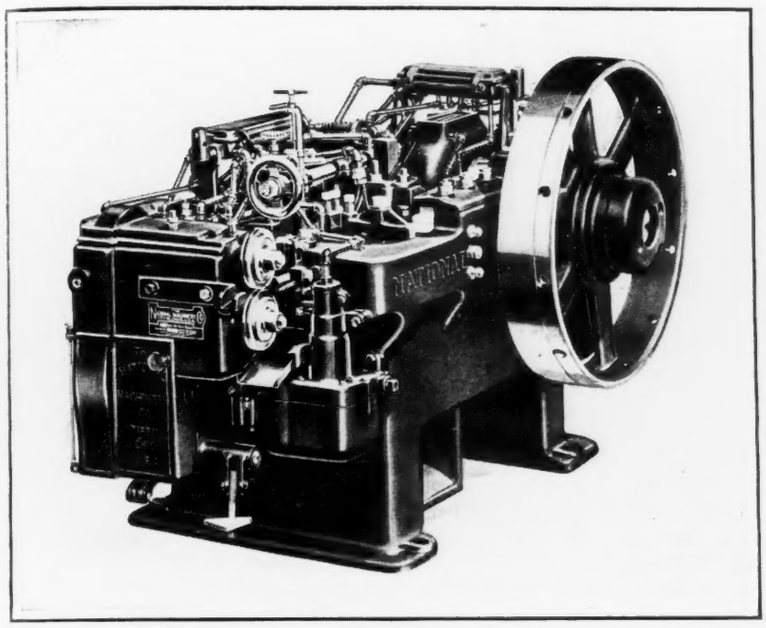


Fig. 1. National Automatic-feed Semi-hot Rivet and Bolt Heading Machine

The 5/8-inch machine will make in a single blow, all classes of bolts, rivets, and upset parts up to 5/8 inch in diameter and 7 inches in length. This machine has a speed range of from 120 to 150 revolutions per minute, and is a size that is especially adapted to cover a range of medium sized work. The bed frame of each machine is short and massive.

The heading slide, which is shown in Fig. 3, is of an unusual design, being greater in length than the distance from the main shaft to the breast-plate of the machine. It is of the over-arm suspended type, and has bearings in back of the crank, in addition to the others. The back bearing in reality guides the front end of the slide, and prevents the heading tool from "winking" or being thrown out of alignment when bolts or other parts requiring a large amount of stock are being made. The bearings are at the top of the slide out of the zone of scale and water.

Another important factor in maintaining alignment of the heading tool is the bolster plate construction, which is also shown in Fig. 3. Various lengths of bolster plates are furnished to insure that the heading tool is always supported firmly and does not overhang, even when making short parts. The bolster plate is screw-controlled in all directions, which enables the heading tool to be quickly and accurately aligned with the gripping dies.

An "angling" feed and shear is employed in these machines, so as to increase the range of the machines to include bolts and other parts requiring a large amount of stock. This "angling" shear compensates for the distortion caused in shearing, with the result that the heads of bolts or rivets are produced central with the body. Also, it makes it possible to upset and fill out an increased amount of stock for large or special heads.

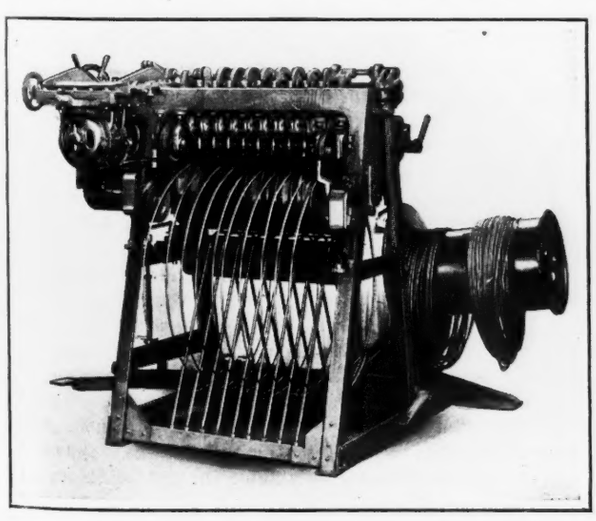


Fig. 2. Coiler used in feeding Stock continuously to the Heading Machine

An adjustment is provided for varying the gripping time to suit various classes of work. There is a new type of grip relief mechanism, which provides all the gripping pressure required for the most difficult work, but limits the ultimate pressure obtainable so that the working faces of the gripping dies cannot be battered or prematurely worn out. An automatic trip in the feed-rolls causes the rolls to part and stop feeding in case the work sticks between the dies. This prevents an accumulation of bent and twisted stock in the grips. The gripping toggles are placed horizontally to enable large-diameter pins to be used and still give a compact design.

An automatic oiling system insures continuous lubrication of fifty-seven bearings, and saves about thirty minutes per day of an operator's or helper's time, as in previous designs all these bearing points were hand-oiled. Special attention has also been given to simplifying the operation of the machines, reducing delays, and permitting quick die changes. Not only is the bender or straightening device adjustable without stopping the machine, but the stock gage is also correspondingly arranged so that adjustments can be made without shut-downs. A new type of ejector pushes the work from the dies instead of kicking or knocking it out, the work clearing the dies by gravity.

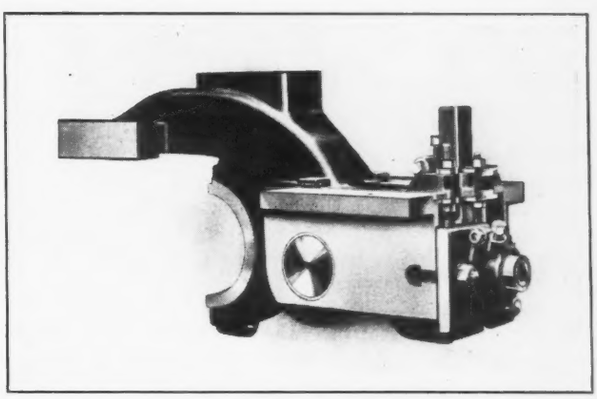


Fig. 3. Heading Slide provided with Bearings in Back of the Crank, in Addition to the Other Bearings

GOODELL-PRATT PORTABLE ELECTRIC DRILLS

Six sizes of portable electric drills are now manufactured by the Goodell-Pratt Co., Greenfield, Mass., the line including 1/4-inch standard, 3/8-inch standard, 1/2-inch light-duty, 1/2-inch standard, 1/2-inch heavy-duty, and 5/8-inch heavy-duty drills. One of the features common to all sizes is the construction of the armature bearing, this part being made of a high-speed bearing metal and provided with a patented wick oiling system that is sealed against oil leakage. With this construction, it is said that even if the drills were used for weeks without oiling, no damage would result to this bearing. All gears are made of a special steel, with wide faces and generated teeth, and are heat-treated. The gear trains are enclosed in a grease-tight compartment, and packed in graphited grease. The chuck spindle is equipped with a thrust bearing.

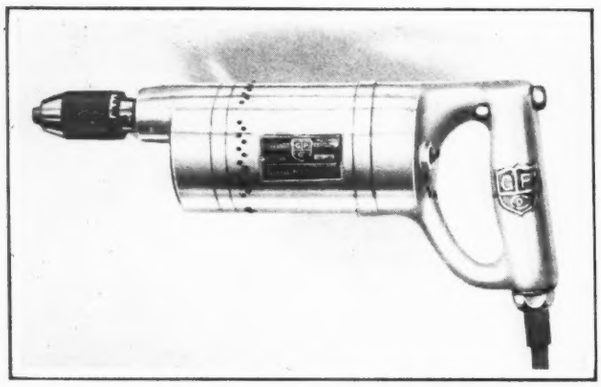


Fig. 1. Goodell-Pratt Portable Electric Drill

The housing is made from aluminum, and finished inside and out. Care has been taken to provide thorough ventilation. A fan draws air through the motor from large holes in the rear casing, and expels it through a large number of smaller holes in the front part of the frame. The location of the inlet holes reduces the chance of sucking in dirt when the drill is laid down. The brushes and armature are readily accessible for repairs and adjustments, by removing the rear plate, and the upper motor bearing is not affected by the removal of this plate. The gear chamber is also easily accessible. All drills, with the exception of the 5/8-inch heavy-duty drill, are equipped with a Goodell-Pratt hand tightening chuck, which can be key-operated in case of emergency. The 5/8-inch heavy-duty drill is provided with a Jacobs chuck.

All motors are of the universal type, for operation on either direct or alternating current, of 110 or 220 volts. Double reduction gearing is used in the drills, even in the case of the 1/4-inch size. Several types of switches are employed, each of which is adapted to the particular drill frame in which it is assembled. The cable is locked to the frame by means of a patented lock consisting of cone-shaped wedges, which are forced into a taper hole and locked. It is claimed that the drill can be held up by the cable alone and severely jerked without loosening the cable or exerting any pull on the terminals.

A feature of the 3/8- and 1/2-inch light-duty drills is a well protected level, set in the top of the frame, which enables the operator to determine whether or not he is holding the drill in a true horizontal plane, when this working position is desirable. From Fig. 1 it will be seen that the 1/4-inch drill is of a straight-line construction, which permits the boring of holes within 3/4 inch of a wall. The weight of this drill is 6 pounds.

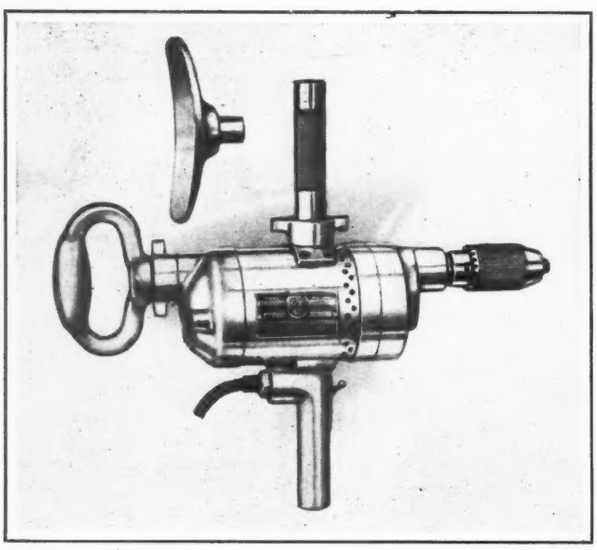
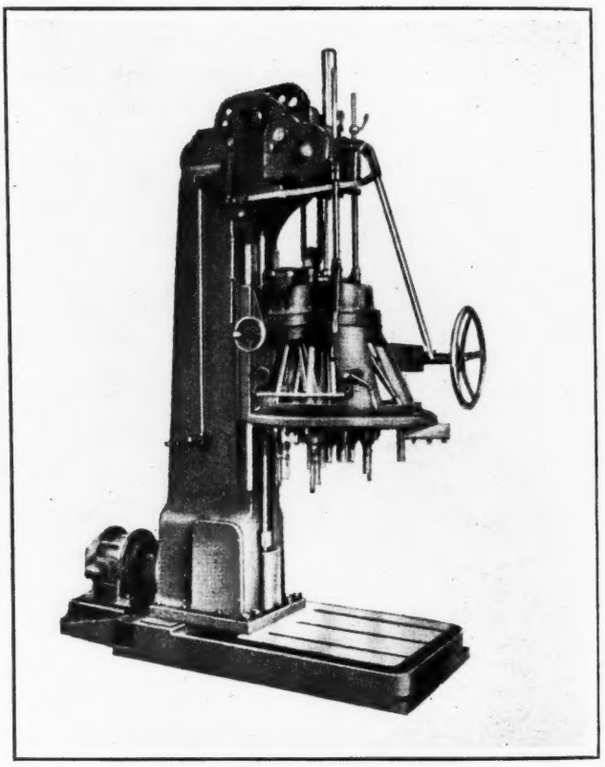


Fig. 2. Drill with Opposed Side Handles, Breast-plate, and Interchangeable Spade Handle

Fig. 2 shows the 1/2-inch heavy-duty drill, which is provided with opposed side handles, a breast-plate and an interchangeable spade handle. This tool weighs 21 pounds. The 3/8-inch drill weighs 11 pounds; the 1/2-inch light-duty drill, 12 pounds; the 1/2-inch standard drill, 16 pounds; and the 5/8-inch heavy-duty drill, 22 pounds. Drill stands are manufactured for the 1/2- and 5/8-inch drills, and a screw feed device for the 5/8-inch drill, which can be used with or without the stand.

BAUSH MULTIPLE-SPINDLE DRILLING MACHINE

A No. 2A high-speed multiple-spindle drilling machine has recently been added to the line built by the Baush Machine Tool Co., Springfield, Mass. One of the features to which particular attention is called is the center feed to the head. The machine may be equipped with 16-, 20-, and 24-inch round heads provided with either twelve or sixteen spindles, and 16- by 30-inch, and 20- by 40-inch rectangular heads provided with either twenty-six or thirty-two spindles. It has



Baush Multiple-spindle Drilling Machine

a capacity for driving eight 1-inch drills or their equivalent in cast iron.

Either a belt or a motor drive can be furnished. With the belt drive, power is delivered from the lineshaft to tight and loose pulleys mounted on a horizontal drive shaft on the bed of the machine. With the motor drive, the motor is mounted on the bed and directly coupled to the horizontal drive shaft. Power is transmitted from the horizontal drive shaft through bevel gears and a vertical shaft to the head and thence through a three-speed gear-box to the spindles. Back-gears in the head give a reduction of 3.1 to 1 in round heads, and 2.6 to 1 in rectangular heads.

The machine is controlled from the front by means of a hand-lever and handwheel. The hand-lever is manipulated to operate a friction clutch in the yoke, by means of which a rapid approach and return of the head are obtained. Close adjustments of the head are made through the handwheel. Three changes of feed are obtainable through sliding gears controlled by means of a hand-lever on one side of the post. Either a box or a rotating table can be furnished. In addition to drilling, the machine can be arranged for tapping,

counterboring, or spot-facing. Oil can be supplied to each spindle.

With the center feed, the feeding pressure is in the center of the head directly over the center of the drill layout. This is said to eliminate any tendency of the head to spring away from the guides of the post under heavy duty, and result in a saving of tools, jig bushings, etc. Practically all bearings throughout the machine are of the ball and roller bearing type. In a motor drive, the motor is of 15 horsepower capacity, and runs at 1200 revolutions per minute.

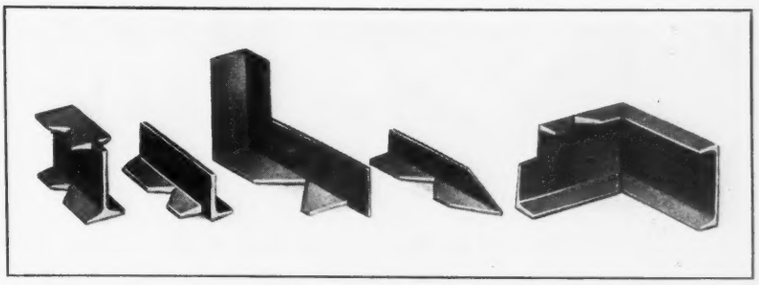


Fig. 2. Examples of Work performed with the Coper

BUFFALO IRON-WORKER WITH COPER

A No. 1/2 universal iron-worker with a built-in coper constitutes the latest addition to the line of "Armor Plate" equipment built by the Buffalo Forge Co., 144 Mortimer St., Buffalo, N. Y. The new machine is particularly useful in

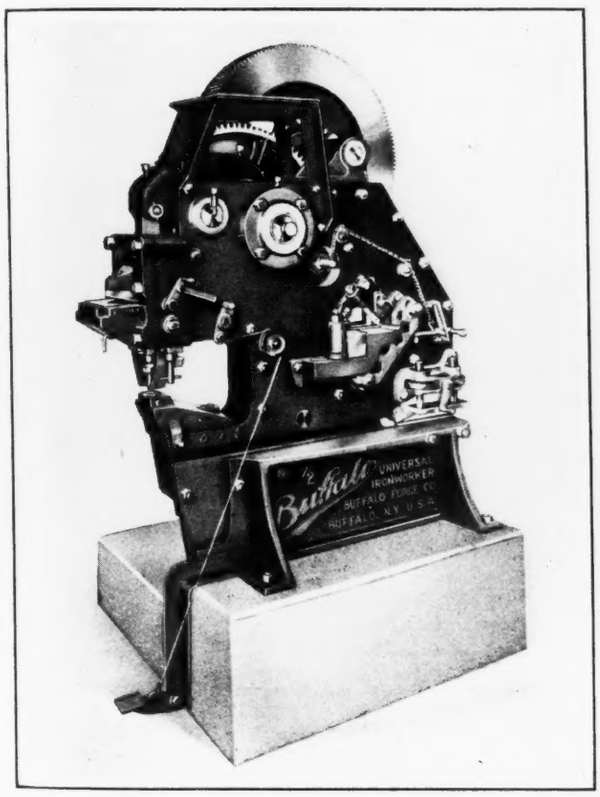


Fig. 1. Buffalo Iron-worker with Coper

shops where much coping work is done on angle-, T-, channel- and Z-irons, I-beams, and other rolled shapes, as well as on plates and flat bars. In addition to the coper, the machine embodies the regular punch, shear, and bar cutter.

The coper is built on the punch end of the machine, as shown in Fig. 1, and is operated by the same plunger and actuated through the same hand or foot controls as the punch. The foot control enables the operator to run the machine while applying both hands to the work. The specific advantage of the built-in coper is that it is not necessary to interchange the coping tools with standard punching tools. The coper can also be furnished with other Buffalo punches, but cannot be applied to machines now in use. A sheet-steel cover guard (not shown in Fig. 1), fits over the coper to protect the operator. On the No. 1/2 iron-worker, the coper handles 5-inch channel-irons, 6-inch I-beams, and 3- by 3- by 5/16-inch angle-irons; while on the No. 1 1/2 machine, 6-inch channel-irons, 7-inch I-beams, and 3- by 3- by 3/8-inch angle-irons can be handled. Only one cut is required for the full depth of all sections.

ARMSTRONG CHROME-VANADIUM STEEL WRENCH

A wrench drop-forged from chrome-vanadium steel has just been brought out by the Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill. This wrench is extra long and extra thin, and constitutes an improvement over the alloy steel wrench which has been made by the same company since 1919. The new wrench is given a special heat-treatment, and is finished in nickel over copper, with the heads buffed bright. By means of this wrench, nuts located in close quarters can be conveniently loosened or tightened.

MITCHELL AUTOMATIC POLISHING MACHINE

A special machine for automatically polishing both sides of strip metal or narrow sheets simultaneously has recently been designed by the Mitchell Engineering Co., Springfield, Ohio. The machine is provided with two wheel-spindles, one above the other, and these may be adjusted vertically to accommodate various thicknesses of material and to compensate for wear of the wheels. Each spindle is driven by a separate motor. The lower motor, in addition to driving the lower wheel-spindle, furnishes power for operating the strip-feeding rollers, as may be seen in Fig. 2. The upper motor also serves a double purpose; besides driving the upper wheel-spindle, it also operates an oscillating mechanism for moving the upper and lower wheel-spindles back and forth sidewise. To permit these movements, both wheel-spindles are mounted on horizontal slides which are superimposed on the vertical slides. The oscillation of the spindles imparts a wavy surface to the strips being polished,

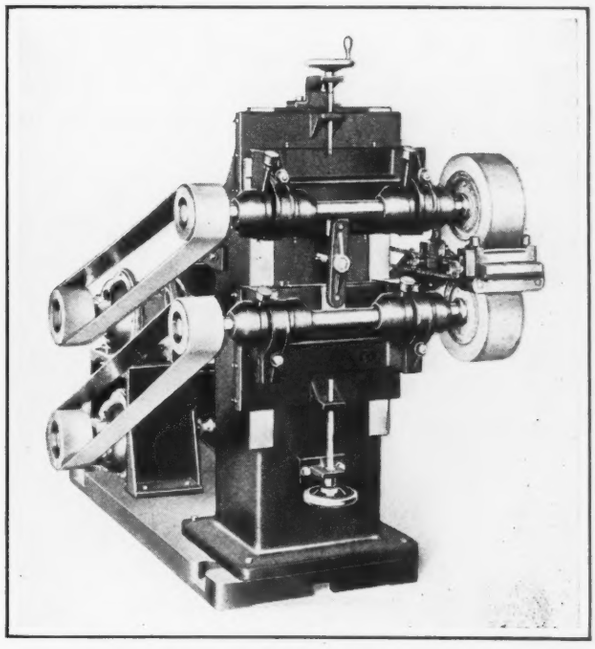


Fig. 1. Mitchell Automatic Machine for simultaneously polishing Both Sides of Metal Strips or Sheets

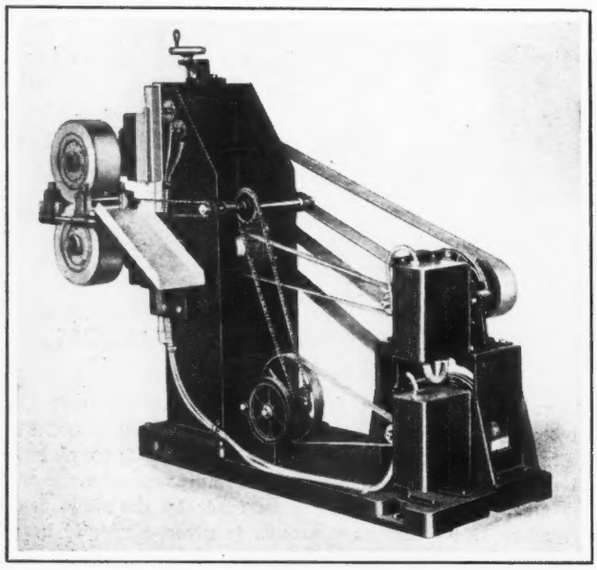


Fig. 2. Rear View of the Polishing Machine, showing Arrangement of Motor Drives

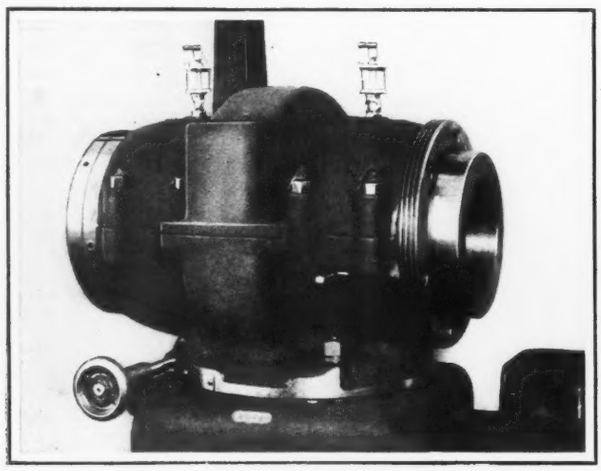
obviates deep scratches in the work, and keeps the wheel faces true and parallel.

In operation, it is only necessary to start the strips into the feed rollers, the rollers then carrying the strips between the wheels and discharging them at the rear of the machine. The rate of feed is dependent upon the material being polished and the finish desired. The machine may be arranged for polishing or buffing only one side of strips or narrow sheets by eliminating the lower spindle and wheel. The weight of the equipment complete with motors, starters, and wheels is approximately 3100 pounds.

HEALD INTERNAL GRINDING MACHINE

A machine intended for grinding long work internally has recently been placed on the market by the Heald Machine Co., 16 New Bond St., Worcester, Mass. The new No. 72 hydraulic internal grinder is provided with a lengthened base that permits a longer grinding stroke than is possible on the standard machine. Holes up to 22 inches in length may be ground. When the work is long, and the hole to be ground is at one end and is not over 6 inches deep, the "Sizematic" features can be applied for automatic grinding.

The machine is also so arranged that center-rests can be easily applied, which is usually desirable with long work and especially when the work is gripped as in a three-jaw chuck. The machine may also be equipped with a large work-head having a hollow spindle such as illustrated. The work may be inserted in this spindle and held in that position.

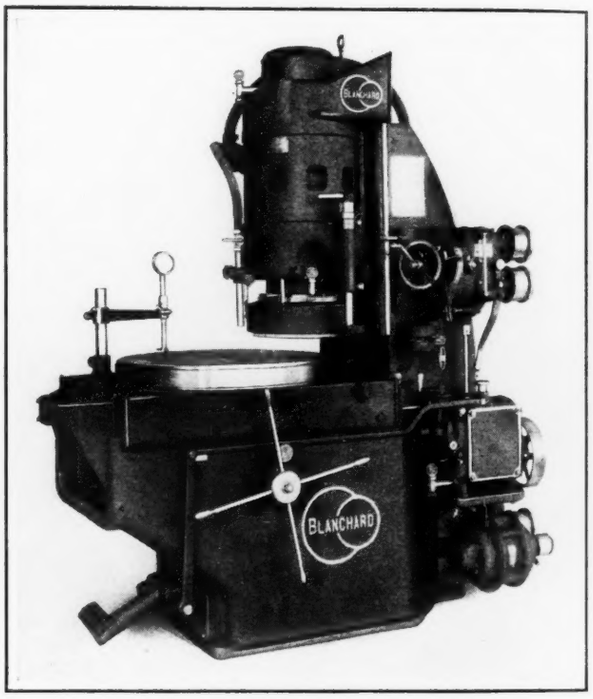


Work-head with Hollow-spindle made for Use on Heald Internal Grinding Machines

BLANCHARD SURFACE GRINDER

The wheel-head of the No. 16 direct motor-driven type vertical surface grinder built by the Blanchard Machine Co., 64 State St., Cambridge, Mass., has recently been improved and simplified. The spindle is now carried in two large ball bearings in the sliding wheel head. The upper bearing is held up by springs, which absorb all end play and place a considerable thrust load in an upward direction on the lower or main bearing. The design is the same as that which has been used for several years in the automatic surface grinder built by this company. The bearings are of the Gurney "Radio-thrust" type, the lower bearing containing eleven balls 1 5/8 inches in diameter. The older type of spindle, which is now used only in the belt-driven machine, also has the spring take-up feature, but there are four bearings consisting of two thrust and one radial ball bearing and a bronze bushing.

The change in the spindle bearings, together with other improvements, gives the new wheel-head the following ad-



Blanchard Surface Grinder with Improved Ball-bearing Wheel-head

vantages: No bearing adjustment required; no maintenance expense on the bearings; small oil consumption; upper bearing entirely covered, so that no moving parts are exposed at the top of the head; wheel guard held directly in the head, eliminating the spider casting formerly required; and more easily cleaned water passage in the head. Hexagon-head screws are used to secure the wheel rings to the faceplate.

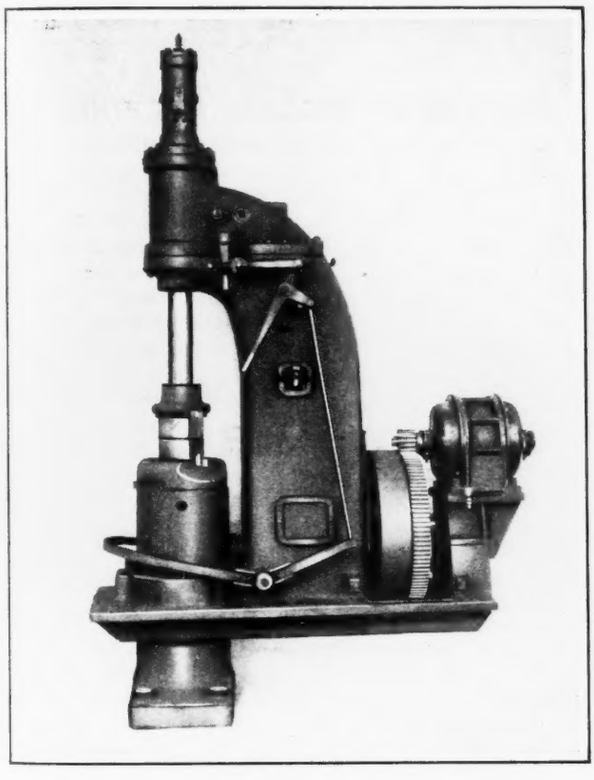
BATES PNEUMATIC FORGING HAMMERS

Pneumatic hammers of the design here illustrated are being manufactured by Williams, White & Co., Moline, Ill., in six sizes for working stock up to 2 1/2, 3 1/2, 4 1/2, 6, 7, and 8 inches square, respectively. These Bates hammers are self-contained, and can be driven by means of a direct-connected motor or from a lineshaft or countershaft. They are designed to deliver full power at the first blow, and to maintain their speed for light finishing blows. Light, medium, or heavy blows can be attained at will by manipulating the treadle or the hand-lever to which the treadle is connected.

When the treadle is released, the ram is lifted to the upper end of the stroke, where it is held suspended as long as the compressor continues running in the idling position. The downward stroke of the ram is produced by injecting com-

pressed air into the upper end of the ram cylinder. The force of the blow is augmented by vacuum created underneath the ram piston, as well as by the compression produced in the top of the compression chamber at the previous upward stroke of the ram. A relief valve equipped with a hand-lever is provided, so that the compressor can be opened instantly in case the hammer is to remain idle for a short time. If the hammer is not to be used for a long period, the motor is shut off or the belt thrown on the loose pulley.

The frame and base are cast in one piece, but the anvil is a separate casting. The lower die-bolster or cap is keyed in a diagonal position to permit working long bars either way of the dies. The upper die-head is solidly attached to the ram, and yet is readily removable. The ram consists of a long solid bar that is the same size for the entire length, and it takes the full force of the blow directly. It is guided both in the upper and lower cylinder heads. Piston-rod packing is unnecessary. The piston-head is forged integral with the body of the ram, and there is no possibility of side pressure from the piston against the cylinder. The two sides of the



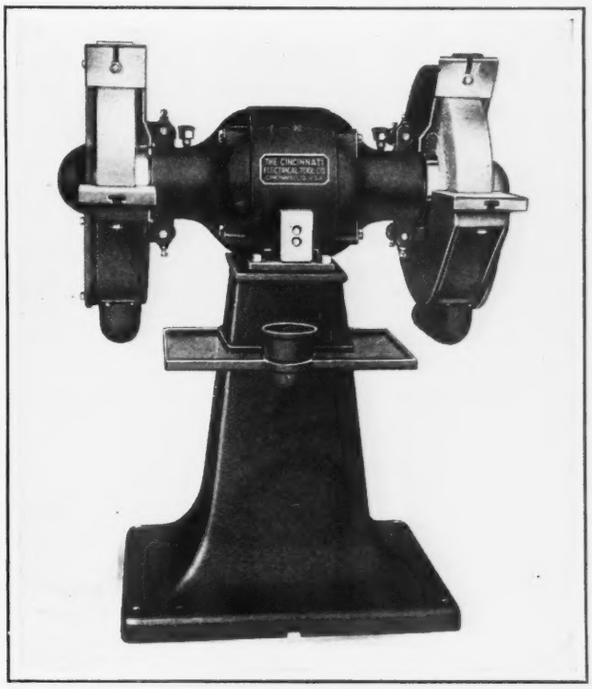
Bates Pneumatic Forging Hammer of Improved Construction

ram are flattened on the upper end where they pass through the cylinder head, so as to prevent rotation of the dies. The various sizes of this hammer give 215, 195, 165, 140, 125, and 115 blows per minute, respectively, and weigh approximately 4000, 6000, 9000, 17,000, 28,000, and 32,000 pounds, respectively.

CINCINNATI HEAVY-DUTY FLOOR GRINDERS

Fully enclosed heavy-duty floor grinders, of 2 and 3 horsepower ratings, are being placed on the market by the Cincinnati Electrical Tool Co., Cincinnati, Ohio. These machines are particularly suited for grinding operations in railway shops, foundries, automobile factories, structural iron works, machine shops, etc. Both machines are provided with ball bearings that are mounted in dustproof housings to compensate for end thrust and eliminate shaft wear. The spindle is ground to size.

The wheel guards are of the exhaust type, and are adjustable to suit the wear of the wheels. Removable covers are



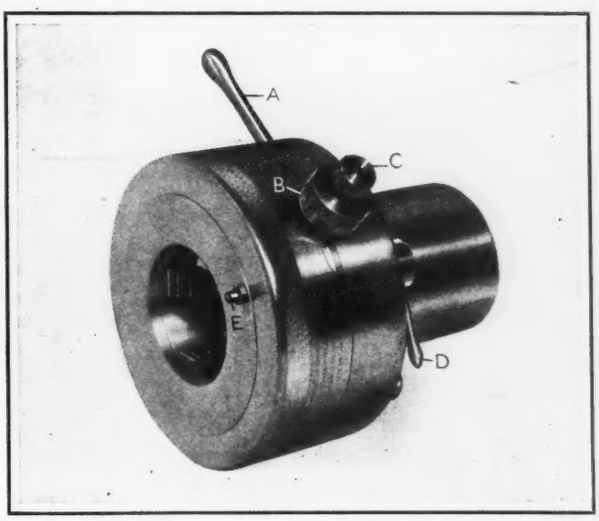
Heavy-duty Floor Grinder built by the Cincinnati Electrical Tool Co.

bolted to the guards to completely enclose the sides of the wheels, flanges, and nuts. The two-horsepower grinder is designed to carry 12- by 2- by 1 1/4-inch wheels, and the three-horsepower machine, 14- by 2 1/2- by 1 1/4-inch wheels. Both grinders may be furnished for either alternating current of 220 or 440 volts, from 25 to 60 cycles and two or three phase, or direct current of 115 or 230 volts.

JONES & LAMSON DIE-HEAD

A No. 7-H die-head of the non-rotating pull-off type has recently been added to the "High-Speed" series manufactured by the Jones & Lamson Machine Co., Springfield, Vt. This die-head has a capacity for work from 3/4 to 2 inches in diameter, inclusive, and supersedes the No. 6 die-head. It is designed to hold and operate the new patented "High-Speed" chasers, which have a ground and lapped thread form. Exclusive of the shank, the die-head is only 4 inches long by 6 3/8 inches in diameter.

When the die-head is placed in the machine, the locking handle *A* is on top, within easy reach of the operator. Directly underneath is an adjusting screw *B* having a double



Jones & Lamson Non-rotating Pull-off Die-head

worm thread at the inner end which meshes with a worm-gear. This worm-gear actuates an eccentric bushing which adjusts the die-head from under-size to over-size in slightly more than one revolution. The adjusting screw is quickly operated, and is locked in position by means of binder *C*. Graduations on the head of the screw, reading to thousandths of an inch, enable accurate settings to be made. The adjusting screw is held in the die body by means of a fine-pitch thread. The "roughing and finishing" lever *D* is located on the operator's side of the die-head.

The cover is locked in position by means of a bayonet lock. Pressure of the thumb on a small button, and a slight turn of the cover, suffices to release the lock so that the cover can be readily pulled from the body to change the chasers. The cam is of the usual construction, but with a deeper bearing on the chasers, and is provided with an outside tripping button *E* which is used for shoulder work or whenever release of the die is necessary.

The chasers are directly on center, and have the points of the threads at a 20-degree top rake or cutting angle. They are also ground with a 20-degree clearance angle and a chamfer or throat angle varying from 15 to 35 degrees to suit the thread depth. A special chaser grinding jig furnished with the die is graduated to meet all requirements. The chasers for work from 3/4 to 1 1/2 inches in diameter, inclusive, are of the extension type to allow the die-head to cut to a shoulder.

ROCKFORD FLANGE-FACING MACHINE

A machine designed primarily for facing flanges on large pipe, after the flanges have been welded on the pipe, is shown in the accompanying illustration. This machine is a recent development of the Rockford Drilling Machine Co., Rockford, Ill. The two head units are made to travel on I-beams so as to accommodate long and offset pipe. The left-hand unit of this particular machine travels in a direction parallel with the center line of the spindle for a distance of approximately 20 feet. The right-hand unit travels approximately the same distance in a direction at 90 degrees to that in which the left-hand head moves. The right-hand head is arranged to index around a complete circle so as to permit placing the spindle of this unit at any required angle in relation to the spindle of the left-hand head. Both units are traversed by hand through the operation of handwheels which function through rack-and-pinion mechanisms.

Each unit is arranged with a direct motor drive, the drive to the spindle being through reduction spur gears. Pick-off gears provide for various speed changes. The spindles have a short feed, which is effected by hand only. The spindle noses are made to suit any star-feed facing head, while the tables are made to suit holding fixtures. Each unit is equipped with a pump, pipe, and tank for cutting lubricant. This machine has a capacity for facing flanges with 24-inch Mummert-Dixon heads.

"STANDART-IZED HI-LIFT" ELECTRIC HOIST

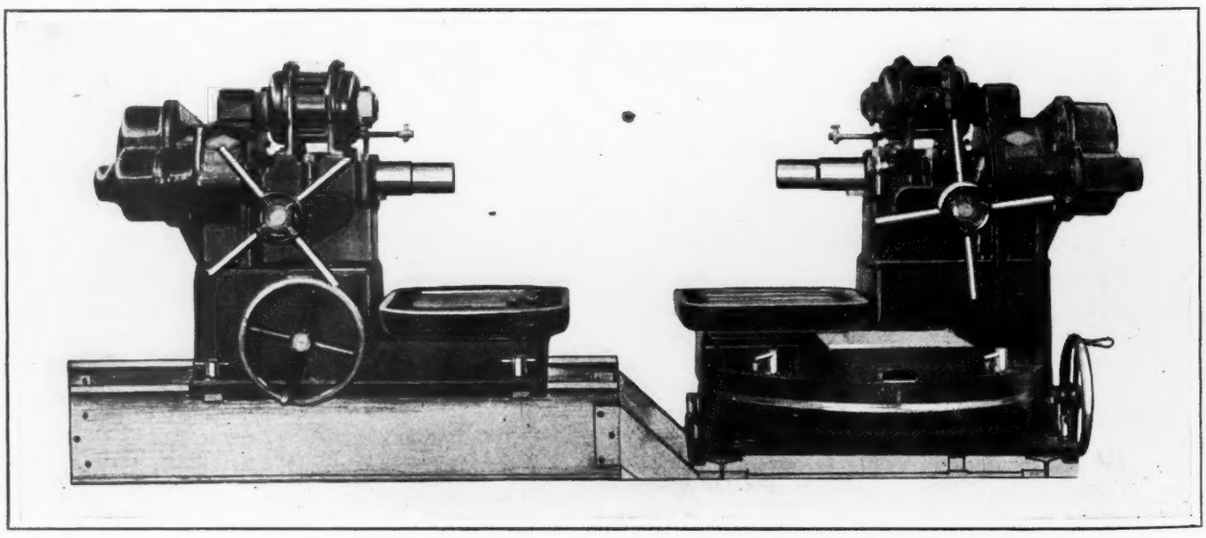
A new electric hoist known as the "Standart-ized Hi-Lift" has recently been brought out by the Northern Engineering Works, Detroit, Mich. The design embodies a high hook lift feature, so that minimum head-room is required; hence, the hoist is available for service in places of limited height. The gears are casehardened, entirely enclosed, and run in lubricant. Timken bearings are provided throughout. The drum and rope sheaves are made large in diameter with a view to providing long life and protection to the steel wire hoisting rope. Safety features include the enclosing of all working parts, two brakes for holding and controlling the load, and a double set of automatic limit stops. The stops not only limit the upward movement of the load hook, but interrupt the downward movement at the proper distance.

OESTERLEIN MILLING MACHINES

A new line of constant-speed or all-geared Ohio milling machines is being introduced on the market by the Oesterlein Machine Co., Cincinnati, Ohio. This line consists of the following sizes: No. 1, No. 2, No. 2 heavy, No. 3, No. 3 heavy, and No. 4. The principal new feature in the design of these machines is the "Veeflat" over-arm. This is a heavy cast-iron over-arm of rectangular cross-section, and the name is derived from the vee and flat guides that form the bearing and provide alignment between the over-arm and the column. An additional advantage is that the over-arm forms a broad and rigid surface to receive the upward thrust of the cut.

The over-arm is clamped by means of a pair of T-slot bolts both at the front and rear of the column. Each pair is equalized and clamped by means of a nut at the side of the machine. The T-slots in the over-arm are located as close as possible to the vee and flat contact surfaces, so that the clamping pressure imposes no strain on either the over-arm or column. The over-arm design permits making the top of the column solid to increase the rigidity.

In-and-out movement of the over-arm is obtained by simply revolving the handwheel. This handwheel is mounted on the end of a shaft carrying a pinion that meshes with a rack on the over-arm. In addition to the advantages already mentioned, the over-arm may be easily operated for

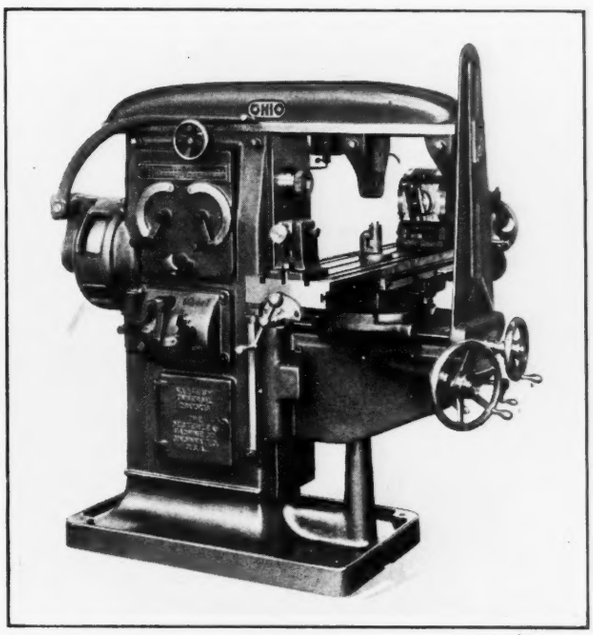


Rockford Two-unit Machine for facing Pipe Flanges

replacing arbors or cutters. Gaging strips are provided on both sides of the overarm. These strips have finished surfaces that are scraped parallel with the center line of the spindle, and are used as locating or gaging points for squaring up work or for locating gaging blocks when working to close limits.

DIVINE POLISHING MACHINE

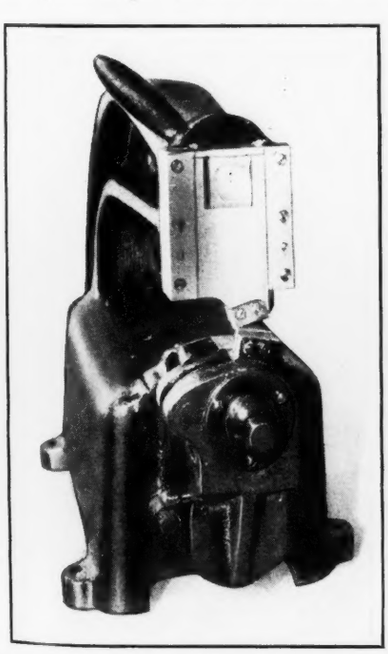
An automatic machine for polishing calculating-machine, cash-register, typewriter, and similar flat parts has recently been developed by the Divine Bros. Co., Utica, N. Y. The parts to be polished are placed on a feed belt which carries them under a series of polishing wheels. Pieces up to several inches in thickness may be handled, and the machine is built in various widths to accommodate pieces up to about 20 inches wide. Contact between the work and the polishing wheels is maintained by a micrometer adjustment. The machine is built in units, each of which carries an independently operated polishing wheel that is driven by an individual motor. Any number of units may be used in one battery to suit the particular polishing process or desired production output.



Ohio Milling Machine with "Veeflat" Over-arm

"UNISHEAR" SHEET CUTTING MACHINE

Cold-rolled steel sheets up to No. 14 U. S. gage, and copper sheets up to No. 12 U. S. gage, can be cut at a speed of 15 feet per minute, in the model 0 domestic "Unishear" recently developed by the Unishear Co., Inc., 170 Fifth Ave., New York City. Sheets can be cut to any outline, and curves having a radius as small as 1/4 inch can be easily followed. Cuts may be conveniently started at any point on a sheet, and not necessarily at an edge. The machine is also intended for cutting leather, rubber, fiber, etc. The construction permits the operator to watch the cut at all times.



"Unishear" for cutting Sheets to Any Outline

The cutting principle is the same as in the machine introduced on the market about six months ago. There is an upper blade which is stationary during the cutting, and a lower blade that is operated up and down at the rate of 1250 cutting strokes per minute. This blade is reciprocated through an eccentric on a shaft near the bottom of the housing. The eccentric shaft is driven by reduction gearing from a 1/4-horsepower General Electric motor, which is located in the base and completely enclosed. The connection between the motor and the driving shaft is a flexible coupling, which saves wear of the motor parts. Power for the motor can be taken from an ordinary lighting socket.

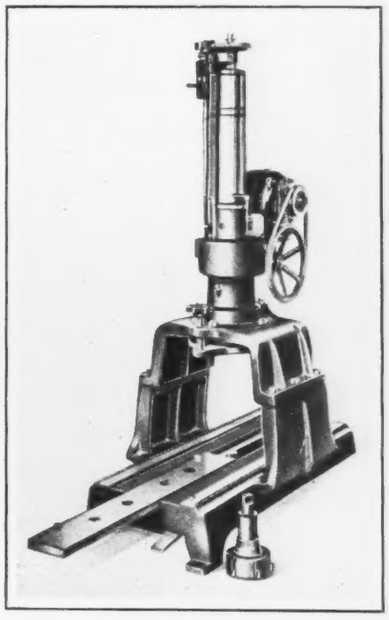
The upper blade is contained in a dovetailed slide that may be raised by means of an eccentric hand-lever to permit sliding a sheet past the blades when it is desired to start a cut in the middle of the sheet. After the sheet has been positioned, the lever is again operated to lower the upper blade. Both blades are easily replaceable, and the clearance between them may be adjusted by inserting shims in back of the upper blade to vary the distance from this blade to the face of the jaw to which it is fastened. By adjusting the clearance, clean cuts without burrs can be made through metal of any thickness.

The standard depth of throat is 15 inches, but greater depths can be provided to meet requirements. The machine is intended to be mounted on a bench without the provision of a special base or pedestal. It occupies a bench space of 24 by 10 inches, is 20 inches high, and weighs about 195 pounds. Obviously, it is readily portable.

STORM CYLINDER REBORING MACHINE

A model F "Stormizing" machine, designed for renewing the cylinders of Ford automobiles and Fordson tractors, has been added to the line of equipment built by the Storm Mfg. Co., Inc., Minneapolis, Minn. In addition to being designed for holding and aligning the cylinder block, the base contains centering and clamping devices. The centering of cylinders is accomplished automatically through the use of a plate that fits a milled channel in the center of the base. Two locating pins at each end of this plate fit the pilot or locating holes originally used in boring the block at the automobile plant. There are four centering holes in the plate, as may be seen in the illustration, and these are spaced to suit the Ford and Fordson cylinder blocks. Each hole is centered under its respective bore.

A centering plunger located in the base directly under the cutterhead is operated through a spring and foot-lever. When the block is advanced into position, this plunger enters the first locating hole in the centering plate, and automatically centers the first

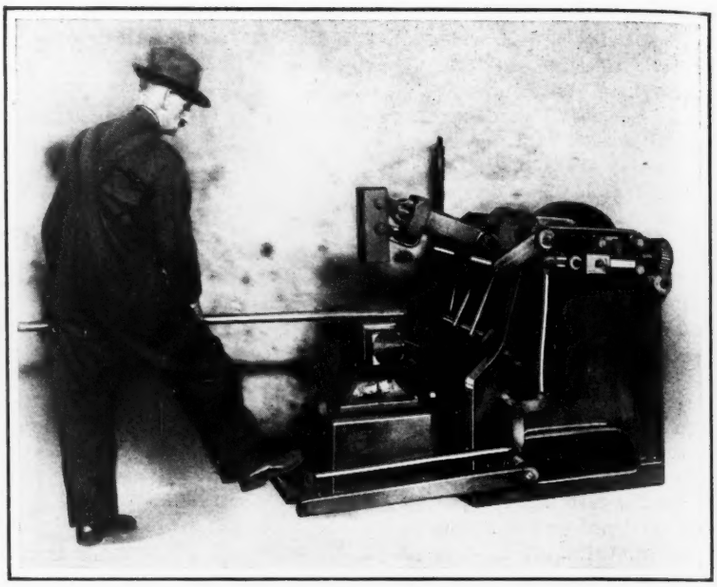


Storm Cylinder Reboring Machine

cylinder bore. The clamping screw is then tightened to lock the block, after which power is applied, and the over-sizing operation is performed automatically. A switch stops the motor when the cutter-head reaches the lower end of the cylinder. After the cutter-head is raised from the cylinder at the completion of an operation, the clamp is released, the centering plunger depressed, and the block advanced to the next centering hole.

CHAMBERSBURG SMITHING HAMMER

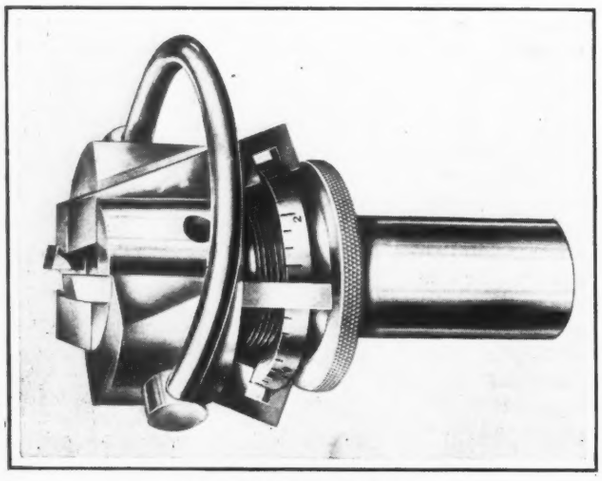
The latest addition to the line of equipment built by the Chambersburg Engineering Co., Chambersburg, Pa., is the smithing hammer or mechanical "sledge man" here illustrated. This hammer is intended as an auxiliary to hand forging operations, and is capable of delivering blows of any intensity from a light tap to a force far beyond what could be exerted by hand. The hammer is so suspended that its face is always parallel with the anvil, so that all blows are struck true. A power traverse operated from the same treadle that controls the blows facilitates working on any part of the anvil face. The hammer head weighs 50 pounds, and strikes a maximum of 218 blows per minute. Two and one-half horsepower is required to drive the hammer, and this power can be transmitted from a lineshaft or from a motor mounted on the frame.



Chambersburg Smithing Hammer

REISINGER ADJUSTABLE HOLLOW MILL

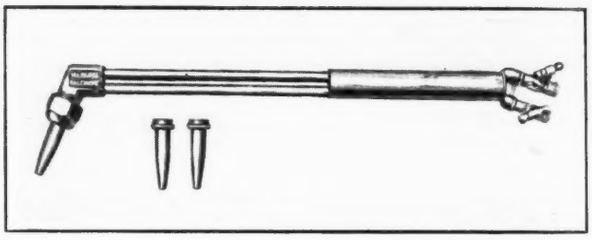
The inserted-blade hollow mill, of adjustable design, here illustrated, is a recent product of the Reisinger Machine Tool Corporation, 839 Lake Ave., Rochester, N. Y. Six of these tools only are required to suit work ranging from 1/16 to 2 1/2 inches in diameter, inclusive. The cutter blades are adjustable in and out by turning the knurled collar, a graduated dial being provided to insure accurate settings. After a setting has been made, all blades are locked in position simultaneously by operating a single-action lever. The blades are also released by this lever.



Reisinger Adjustable Hollow Mill

MILBURN WELDING TORCH

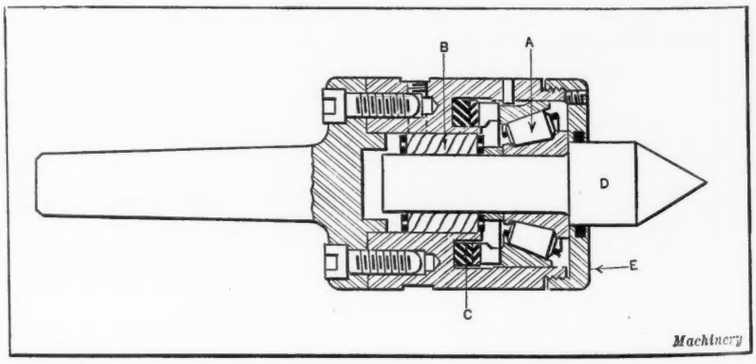
A small welding torch known as the type J-Jr. has been brought out by the Alexander Milburn Co., Baltimore, Md., for use with work that does not require the usual standard torch. The torch uses the same tips as are supplied with the larger standard torches, and is adaptable to all classes of welding. It uses low and approximately equal pressures of oxygen and acetylene. The seats of the tips are flat with annular grooves coinciding with those in the head, the gas passages entering through the annular grooves or rings that separate the gases. The construction of these seating surfaces allows lateral expansion of the torch head and tip without distortion, and the seats are easily refaced. The torch can be used with gas supplied either from generators or tanks. It is 18 inches long and weighs only 25 ounces.



Milburn Light-weight Welding Torch

"FRICTION-LESS" LIVE CENTER

A "Friction-less" live center in which two roller bearings are incorporated is being manufactured by the Precision Gauge & Tool Co., 6482 Epworth Blvd., Detroit, Mich. In the front of this device, there is a tapered roller bearing *A*, while in the rear a straight roller bearing *B* maintains alignment. Back of the front bearing cup there is a resilient composition pad *C* which relieves the bearing from shocks.



Construction of "Friction-less" Live Center made by the Precision Gauge & Tool Co.

It also takes care of expansion of the work due to heat from the cutting tools and automatically compensates for wear on the front tapered roller bearing. Adjustments of the device are accomplished by means of the knurled collar *E*. The tool steel center *D* is made to suit requirements. Detachable taper shanks of any type or size may be furnished to be changed at will. When properly adjusted to the work, this center requires no further adjustment until the operation has been completed.

TRENT ELECTRIC MELTING POT

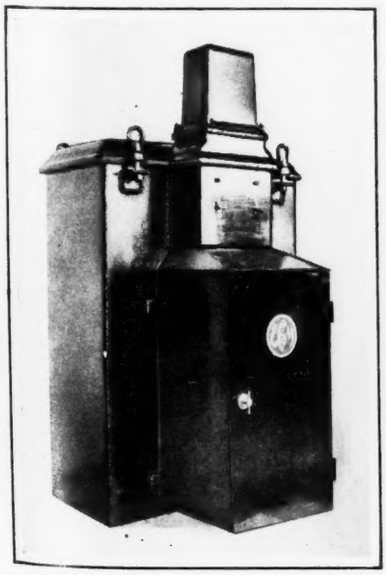
The line of melting pots manufactured by Harold E. Trent, 259-261 N. Lawrence St., Philadelphia, Pa., has been extended to include the 45-pound pot here illustrated. This

Trent Electric Melting Pot for Babbitt, Lead, Tin, etc.

pot is controlled by means of a three-heat switch, and has a separable plug connection. The pot is adapted to ladle and dipping work, and it is provided with a spout and handle to facilitate pouring. Babbitt, type metal, solder, lead, tin, and similar metals can be melted.

HIGH-VOLTAGE SYNCHRONOUS MOTOR CONTROL

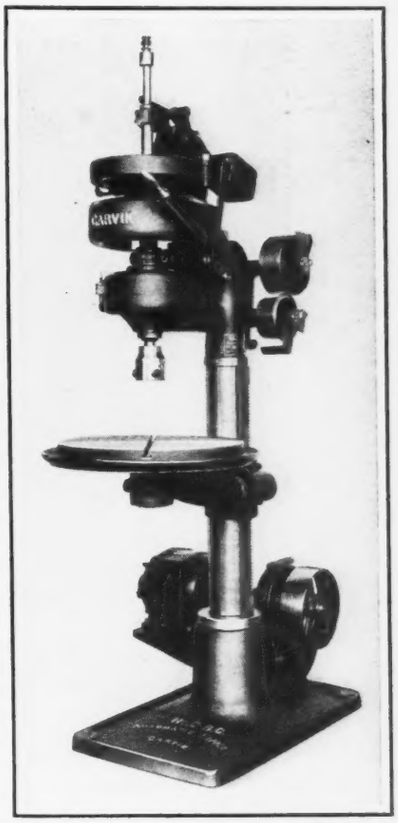
A self-contained oil-immersed automatic starter for 2300-volt synchronous motors has been developed by the Electric Controller & Mfg. Co., 2700 E. 79th St., Cleveland, Ohio. This control is built for across-the-line starting of slow-speed motors and for reduced-voltage starting of high-speed motors. The illustration shows a reduced-voltage starter. With each equipment, the operator simply pushes a button to start the motor, and as the motor approaches the synchronous speed, the field excitation is automatically applied. The equipment is complete in a single unit.



Synchronous Motor Control built by the Electric Controller & Mfg. Co.

GARVIN TAPPING MACHINE

An improved Garvin No. 2-BG automatic tapping machine has been brought out by the Western Machine Tool Works, Holland, Mich. From the illustration it will be seen that the machine is equipped with guards around the friction pulleys and with a compact motor drive. The motor is of 1 1/2 horsepower capacity. This machine may be used for tapping U. S. standard threads up to 1 1/4 inches in cast iron or 3/4-inch pipe threads in cast iron. Holes up to 2 1/2 inches deep can be tapped. The distance from the center of the spindle to the column is 12 1/2 inches, and the movement of the spindle, 4 inches. The vertical adjustment of the table is 20 inches.

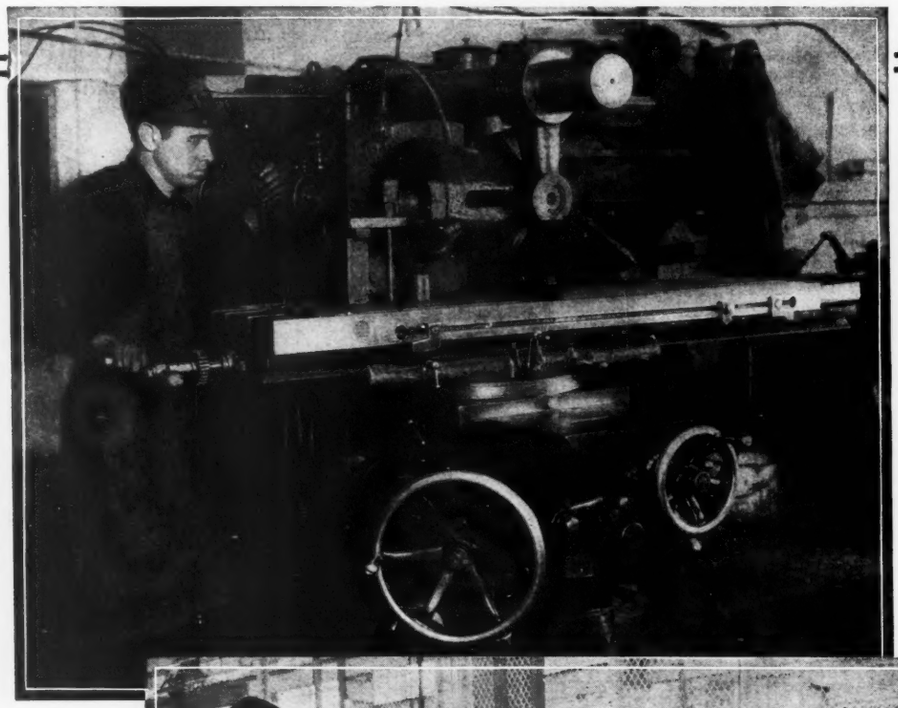


Garvin Automatic Tapping Machine of Improved Design

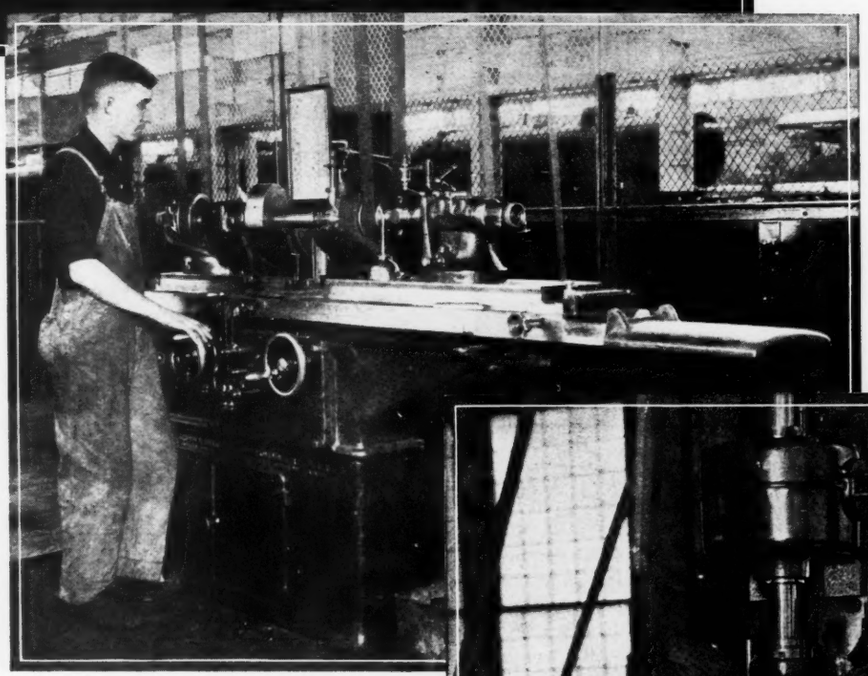
RYERSON HAND SHEAR FOR CORRUGATED SHEETS

A self-feeding hand-operated portable shear has just been placed on the market by Joseph T. Ryerson & Son, Inc., 16th and Rockwell Sts., Chicago, Ill., for cutting corrugated sheets. The shear may be used to cut straight, on a curve, or oblique-

Applying the Ryerson Portable Shear for Corrugated Sheets

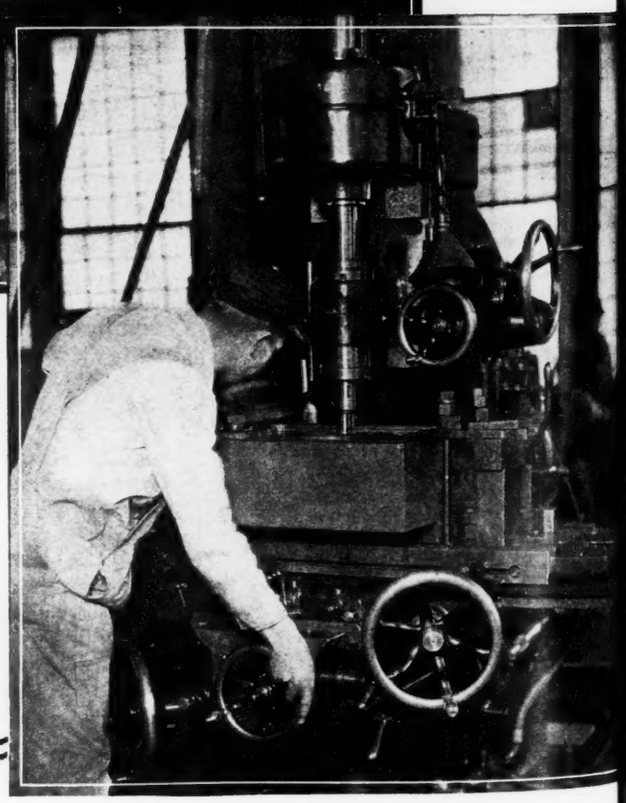


Machining a crosshead keyway on a Brown & Sharpe No. 4A Universal Milling Machine. The adaptability of these machines for milling many of the larger pieces in the repair shop is evident. This type of machine is just as useful for tool-room work.



The above view shows a typical installation of a Brown & Sharpe Universal Grinding Machine. For cylindrical, taper, internal, face, or the simpler forms of cutter and tool grinding, this type of machine has proved a steady, dependable worker in hundreds of shops.

Ruggedness is an inbuilt quality of all Brown & Sharpe Milling Machines that immediately impresses even the casual observer. At the right is an example of this ruggedness put to use, a heavy die-sinking operation with a No. 3 Vertical Spindle Milling Machine



Brown & Sharpe Machines are heavy enough, accurate enough, and easily enough operated to make new low records on your repair costs

WHEN you are ready to buy new equipment, remember these features of Brown & Sharpe Machines.

Weight where weight is needed

All types of machines are built in sizes heavy enough and otherwise suitable for railroad shop work. The inbuilt ruggedness reduces chatter and insures accurate work.

Dependable Accuracy

All Brown & Sharpe Products are built up to a degree of accuracy that has stood unsurpassed for over half a century as the "Standard of the Mechanical World."

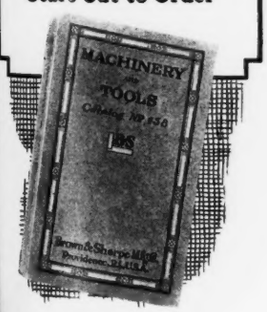
Ease of Control

Every possible improvement is made to insure simplified machines. An operator with limited experience can run a Brown & Sharpe machine with little help and checking by the foreman.

Three of many railroad shop installations are illustrated on the opposite page. Let our representatives go over the matter of size and type with you and help you effect modern low cost records in your shop.

Brown & Sharpe Products

Milling Machines
Grinding Machines
Gear Cutting Machines
Screw Machines
Cutters and Hobs
Machinist's Tools
Gears Cut to Order



BROWN & SHARPE

BROWN & SHARPE MFG. CO. PROVIDENCE, R. I., U. S. A.

Brown & Sharpe Cutters and Small Tools are used extensively in railroad shops all over the world because of their accuracy and dependability. Catalog No. 138 lists the complete line, including Machines, Tools, and Cutters. Send for your copy.

ly across the corrugations without causing any distortion. After the cut has been started, the feed and relative movement between the sheet and shear are automatic.

The cutting is done by a pair of rotary double-edged cutters, which are knurled around the shearing edges. The upper cutter is driven by an internal ratchet which is operated by the handles, while the lower cutter runs free. The driven cutter is adjustable by means of a cap-screw to insure a continuous even feed on all sheets. Withdrawal of the tool from the sheet at any point may be accomplished by simply loosening the adjusting screw. This feature permits the cutting out of corners or angular pieces. Sheets up to No. 20 gage can be cut.

* * *

PERSONALS

W. C. MACBAIN, general foreman of the Porter-Cable Machine Co., Syracuse, N. Y., has been made superintendent.

FRANCIS A. EMMONS, for the last two years advertising manager of Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill., has recently been appointed sales manager.

F. S. KNOWLES was elected president and general manager of the LaSalle Tool Co., LaSalle, Ill., manufacturer of grinding machines, at a recent meeting of the board of directors.

JOHN J. C. GLESMANN, tool engineer for the last twelve years at the American Bosch Magneto Corporation's plant at Springfield, Mass., has severed his connection with that concern, effective June 1.

W. BURR BENNETT, who was formerly production manager of the Commercial Truck Plant of the American LaFrance Fire Engine Co. at Bloomfield, N. J., is now in charge of production of the Maccar Truck Co. in Scranton, Pa.

RALPH SIMPSON, for many years with the Potter & Johnston Machine Co., Pawtucket, R. I., has been appointed sales manager of the Leon J. Barrett Co., Worcester, Mass., manufacturer of the Curtis centrifugal oil extractors and dryers.

R. F. FISKE, for several years manager of the R. D. Nuttall Co.'s eastern office at Philadelphia, has been appointed sales manager in place of Q. W. HERSHEY. JOHN E. MULLEN, of the home office sales force, will be assistant sales manager.

C. H. WHITING, formerly methods engineer of the De Jon Electric Corporation, Poughkeepsie, N. Y., is now Detroit representative for the Van Norman Machine Tool Co. of Springfield, Mass. Mr. Whiting is located at 5047 Dailey Ave., Detroit.

R. H. BETHEA has been appointed resident manager of the McLain-Simpers Organization, Stock Exchange Bldg., Philadelphia, Pa., for the southern territory. Mr. Bethea's headquarters will be at the Chamber of Commerce Bldg., Greenville, S. C.

HENRY EGGELHOF, Box 945, Dallas, Tex., was recently appointed exclusive representative for the eastern half of Texas by the Uehling Instrument Co. of Paterson, N. J., manufacturer of power plant recording instruments.

CHARLES H. CLARK has recently been appointed raw material salesman for the Bridgeport Brass Co., Bridgeport, Conn. Mr. Clark's territory will cover the state of Massachusetts and the cities of Providence, R. I., and Meriden, Conn. His headquarters will be at 1488 Commonwealth Ave., Allston, Boston, Mass.

E. P. WELLES, president of Charles H. Besly & Co., Chicago, Ill., and Beloit, Wis., sailed, accompanied by Mrs. Welles, April 30 on the *Rotterdam* for a three months' stay in Europe, during which time he expects to visit France, Italy, and England.

ROBERT NEAL PIPER, formerly sales representative for the National Automatic Tool Co., in the Buffalo territory, has joined the organization of the Cincinnati Shaper Co., Elam St. and Garrard Ave., Cincinnati, Ohio, in the capacity of sales engineer.

DONALD M. CROSSMAN has resigned as advertising manager for the Niles-Bement-Pond Co., 111 Broadway, New York City. After sixteen years' service with this company, Mr. Crossman is planning to see some of the world before making a new connection. He sailed for Europe on May 27, and plans to be back about October 1.

W. SCOTT THOMAS, 316 National Exchange Bank Bldg., Providence, R. I., has been appointed special foundry equipment sales representative in the New England section for the Northern Engineering Works, Detroit, Mich. Mr. Thomas has previously been connected with the J. W. Paxon Co. in charge of their New England business.

JOHN A. CAMM, formerly sales manager for the Kearney & Trecker Corporation, Milwaukee, Wis., has joined the sales force of the Seneca Falls Machine Co., Seneca Falls, N. Y., and will represent that company in the sale of "Lo-swing" and "Short-cut" lathes in the Chicago territory. Mr. Camm's headquarters will be at 662 Forty-eighth St., Milwaukee, Wis.

RONALD WIXSON has joined the sales organization of the Bonney Forge & Tool Works, Allentown, Pa., and will sell the C-V line of wrenches with other Bonney products in Florida, Georgia, North Carolina, South Carolina, Virginia, and West Virginia. I. K. FOX will handle these products in Colorado, Kansas, part of Louisiana, Arkansas, New Mexico, Oklahoma, and Texas.

J. I. BURGESS is handling the sale of machine tools and threading tools made by the National Acme Co., Cleveland, Ohio, in the so-called "home territory," which includes Ohio, Kentucky, and West Virginia. W. G. FURLONG will handle the sales of all the products of the company in the Buffalo territory, effective June 1. H. S. MITCHELL has been appointed purchasing agent of the company.

R. C. DICK FELTES has been appointed district manager of the Chicago territory of the Hisey-Wolf Machine Co., Cincinnati, Ohio, manufacturer of portable electric drills, grinders, and buffers. Mr. Feltes' headquarters will be at 549 W. Washington Blvd., Chicago, Ill. He previously served for twelve years as district manager of the Chicago office of the United States Electrical Tool Co. of Cincinnati.

J. E. WALKER, of the H. H. Franklin Mfg. Co., Syracuse, N. Y., was elected president of the Purchasing Agents of Syracuse and Central New York at a recent meeting in Syracuse. The other officers elected were: C. L. MARSTERS, Norwich Pharmacal Co., first vice-president; D. C. PARK, Smith & Caffrey, second vice-president; H. G. DUNN, Brown Lipe Gear Co., treasurer; and W. E. HOPTON, The Hopton Co., secretary.

E. HOLGERS has become a member of the firm of B. Eichwald & Co., 51 E. 42nd St., New York City, electrical engineers and contractors. The firm specializes in making layouts for industrial electrical installations. Mr. Holgers has been connected with Dwight P. Robinson & Co. of New York for the last six years, as supervising engineer in charge of industrial electrical work, and was for ten years previous with Westinghouse, Church, Kerr & Co., as assistant engineer and engineer in charge of electrical work.

H. KEMPNER has been appointed sales manager of the "Lo-Hed" electric hoist division of the American Engineering Co., Philadelphia, Pa. Mr. Kempner has been in charge of sales promotion work for the company, including the handling of the advertising and publicity, for the last three years. He was previously connected with the engineering department of the Western Electric Co., designing telephone apparatus and inspecting and testing central station installations. From 1919 to 1923, Mr. Kempner was in the service of the McGraw-Hill Publishing Co.

J. MCA. DUNCAN, for fourteen years Pittsburg district manager of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been promoted to the position of assistant general sales manager. W. R. MARSHALL, formerly branch manager at Buffalo, N. Y., will assume the duties of Pittsburg district manager. H. F. BOE, formerly industrial division manager at Buffalo, has been promoted to branch manager of that office, and R. L. KIMBER has been made industrial division manager. W. F. BARNES has been appointed branch manager of the Tulsa office of the company.

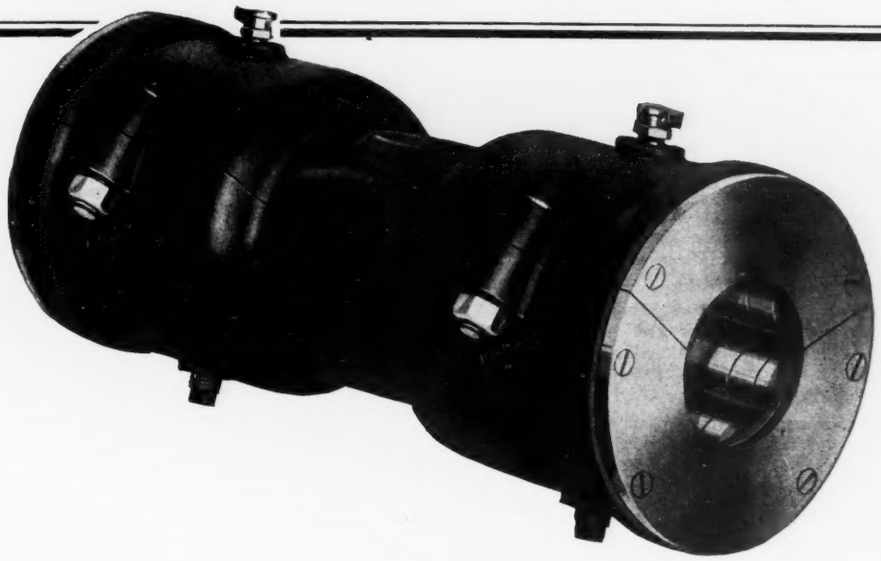
T. F. ROSE, formerly assistant manager of the Chicago branch of the Timken Roller Bearing Service & Sales Co., Canton, Ohio, has been appointed manager of the Cincinnati branch. H. C. SAUER has been appointed manager of the Detroit branch of the company. Mr. Sauer was formerly assistant branch manager at Cleveland. FRED G. RUMBALL, formerly manager of the Kansas City branch, has been promoted to the position of sales engineer of the Automotive Division of the Timken Roller Bearing Co., and EDGELEY W. AUSTIN will be assistant manager of sales. Mr. Rumball and Mr. Austin will be located at Cleveland. J. M. CAREY will fill the position of branch manager at Kansas City vacated by Mr. Rumball.

* * *

AMBROSE SWASEY HONORED

A testimonial dinner was given on May 14 in honor of Ambrose Swasey, chairman of the board of the Warner & Swasey Co., Cleveland, Ohio, by a great number of his friends, under the auspices of the Cleveland Section of the American Society of Mechanical Engineers. Addresses were made by Charles F. Brush and Dexter S. Kimball. Many letters and telegrams were received from every part of the country, Herbert Hoover and Thomas Edison being among those who expressed their appreciation of the work of Mr. Swasey in the development of the mechanical means that have done so much for the furthering of civilization.

Older than the century —and still going strong



Hyatt Line Shaft Roller Bearings are built to endure. Many have already served thirty years—and aren't old timers yet.

Hyatt bearings are rugged, and don't wear. They are flexible. The helically-wound rollers absorb loads, vibration and irregularities in shaft surfaces. Their full line contact prevents overloading, reduces friction and saves 15% of your power bill.

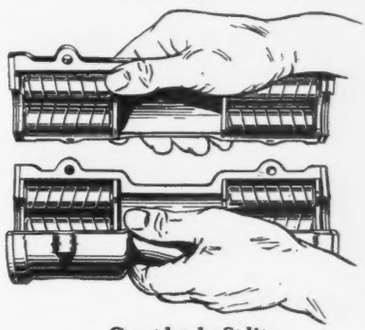
Lubrication is required only three or four times a year—cutting oil and labor costs. One installation paid for itself in eight months and is now earning 174% annual dividends.

Bearings and boxes are split, for quick installation, without disturbing shaft fittings. They are quickly adjusted to any hanger. The new *narrow center* Hyatt bearing extends Hyatt service and economies to narrow transmission lines.

Send for Hyatt Line Shaft Bulletins 130 and 134, or ask your local mill supply dealer for details.

These companies have used Hyatt Line Shaft Roller Bearings, in quantities of 200 to 30,000, for twenty years and more:

Colburn Mach. Tool Co. Franklin, Pa.	20 years
Ford Motor Car Co., Detroit	20 years
Harley-Davidson Mf'g. Co. Milwaukee	20 years
United Shoe Mach. Co. Beverly, Mass.	20 years
Wallace Barnes Co. Bristol, Conn.	20 years
Whitin Machine Co. New London, Conn.	24 years
Davis Sewing Machine Co. Dayton, Ohio	25 years
Roanoke Mills Roanoke Rapids, N. C.	30 years
Greenfield Tap & Die Corp. Greenfield, Mass.	33 years



Completely Split for Easy Installation

HYATT ROLLER BEARING COMPANY
Newark, New Jersey
Pacific Coast Address: San Francisco, Cal.

HYATT
ROLLER BEARINGS

Nearly two million Hyatt Line Shaft Roller Bearings are now in use.

TRADE NOTES

FERGUSON GEAR CO., Gastonia, N. C., is erecting additional buildings, which will provide about three times the present manufacturing space.

APEX MACHINE CO., manufacturer of drill chucks, tapholders, die-heads, and universal joints, is now located in its new factory at 300 Davis Ave., Dayton, Ohio.

NATIONAL ELECTRIC MFG. CO., Pittsburg, Pa., maker of Syntron electric hammers, has changed the company name to the SYNTRON CO., to correspond with the trade name of its products.

HALCOMB STEEL CO. has moved its New York branch office and warehouse from 401 Canal St., New York City, to the corner of Clarke and Dominick Sts., where it will occupy the entire building.

BOTFIELD REFRACTORIES CO., Swanson and Clymer Sts., Philadelphia, Pa., has appointed the Standard Asbestos & Cork Co., 541 S. Troost St., Tulsa, Okla., distributor for "Adamant" fire-brick cement.

JOSEPH T. RYERSON & SON, INC., 16th and Rockwell Sts., Chicago, Ill., have taken over the Reinforcing Bar Division of the Penn Metal Co., Boston, Mass. Sales offices have been opened at 677 Concord Ave., Cambridge, Mass.

ROBERT JUNE ENGINEERING MANAGEMENT ORGANIZATION, Detroit, Mich., has moved to larger quarters at 2208 W. Grand Blvd., where it now occupies the entire building. The new building gives the organization greatly added facilities.

CINCINNATI ENGINEERING TOOL CO., Cincinnati, Ohio, has opened an office at Room 1810, Singer Building, 149 Broadway, New York City. THE STOCKBRIDGE MACHINE CO., Worcester, Mass., has also opened a New York office at the same address.

DONAHUE STEEL PRODUCTS CO., INC., Chicago, Ill., specialist in the purchase and resale of forging, bolt, nut, and rivet machinery, is combining its office and warehouse in the plant formerly occupied by the Walworth Mfg. Co. at 1147 S. Washtenaw Ave., Chicago.

STANDARD STEEL & BEARINGS, INC., Plainville, Conn., announces that in order to round out its service to the automotive and industrial fields, it has added to the SRB annular ball bearing line a complete series of thrust bearings identified by the trademark M-R-C.

FIBROC INSULATION CO., 1023 Lincoln Ave., Valparaiso, Ind., announces that it has been allowed patents on a new self-lubricating bakelite to be used in making gears. The company has published a booklet "Silent Gears in Industry" which gives complete details of the new material and its uses.

NATIONAL MACHINE & TOOL CO., 801 S. Water St., Jackson, Mich., manufacturer of garage tools, is adding a building 40 by 60 feet to its present manufacturing space, which will increase, by about one-third, the floor space that the company now occupies. The new building is of modern steel and glass construction.

A. & F. BROWN CO., has moved its sales department and stock-room to the general office and works at Third St. and Port Ave., Elizabethport, N. J. It is believed that this change will increase the efficiency of both the sales and production departments and eliminate delays due to having the two departments separated.

TIMKEN ROLLER BEARING SERVICE & SALES CO., Canton, Ohio, announces that the branch office of the company located at 1033 Cathedral St., Baltimore, Md., was closed May 1. The service requirements of Timken customers in this territory will be supplied through the Richmond, Pittsburg, and Philadelphia branches.

LINDLEY-DUNNING MFG. CO., 5120 Wakefield St., Germantown, Philadelphia, Pa., has been incorporated under the laws of the state of Pennsylvania to manufacture pumps and equipment for electric refrigeration. The firm has been organized by Elmer D. Dunning, formerly vice-president and general manager of the Dunning Compressor Co. of Philadelphia, Pa., and by George W. Lindley and F. I. Rennie.

J. H. WILLIAMS & CO., Buffalo, N. Y., have announced the addition of tappet and check nut wrenches to their line of chrome-molybdenum "Superrenches." These are especially designed for tappet adjustment, their length being ample to prevent burning the hands while working on tappets when the motor is hot—the only time for such service. They are furnished heat-treated and nickel-finished, with heads buffed bright.

GISHOLT MACHINE CO., 1300 E. Washington Ave., Madison, Wis., announces that the company will exhibit its new full swing side carriage turret lathe No. 4-L, with fixed center turret, and the 3-L machine, with the cross-feed turret, as well as the No. 4-B universal small turret lathe and the internal and link grinder, at the Railway Supply Manufacturers Association's exhibit in Atlantic City, June 9 to 16. These machines will all be shown in operation on typical railroad work.

HUSKY WRENCH CO., Milwaukee, Wis., announces that in order to take care of its increased business and provide manufacturing space for the completed line of socket wrench sets and interchangeable soft-tip hammers, the executive offices and factory of the company have been moved to 27th and Florence Sts., Milwaukee. The export office will remain at 280 Broadway, New York City. The officers of the company are: John G. Zummach, president and treasurer; Sigmund Mandl, vice-president; and Joseph Wirtish, secretary.

WARNER & SWASEY CO., Cleveland, Ohio, announces that the company will exhibit a new No. 3-A turret lathe of 7 1/2 inches capacity at the Railway Supply Manufacturers' exhibit in Atlantic City, June 9 to 16. The machine will be in constant operation producing large cross-head pins with standard tool equipment. In addition, there will be exhibited a No. 2-A universal hollow hexagon turret lathe producing locomotive frame bolts. This machine will be equipped with a new taper-turning tool designed for railroad use. The new line of W. & S. portable pneumatic tools will also be demonstrated.

ELECTRIC ARC CUTTING & WELDING CO., 152-158 Jelliff Ave., Newark, N. J., announces that the company has obtained a decree in the District Court of the United States, Eastern District of New York, asserting that the patents issued to C. J. Holslag, numbered 1,305,360 for alternating-current welding transformers; 1,305,363 for alternating-current metallic arc cutting and welding apparatus; 1,528,425 for improvements in metallic arc cutting and welding apparatus; and the reissue No. 16,012 for improvements in the methods of electric arc welding, cutting, and repairing, are good and valid in law, and that the making of apparatus as described in and protected by these patents is an infringement.

HALL-WILL INC., Erie, Pa., has been organized by Leslie S. Hall, who is president of the new corporation, and C. Frank Williams, who is vice-president. The company will manufacture pipe threading machinery, concentrating at first on a medium-priced, portable, power-driven pipe threading machine capable of high production of accurate work at low cost. The first machine to be placed on the market will have a capacity of from 1/4 inch to 2 inches, and this will be followed by a line of larger machines. For the last five years Mr. Hall has been vice-president and general manager of the Williams Tool Corporation of Erie, Pa., and has designed many types of threading machines. Mr. Williams was general superintendent of the same company for many years; since 1921 he has been associated with the Erie Steam Shovel Co., which connection he will continue to hold in an advisory capacity. Gordon C. Hay will be sales manager, and J. W. McLeod, works manager.

PRATT & WHITNEY CO., Hartford, Conn., has undergone a complete reorganization, both in regard to the personnel of the engineering and sales forces and with respect to the plant and plant equipment. Buildings have been renovated, modern machinery in large quantities has been installed, twenty-six carloads of second-hand machinery have been shipped out of the plant, and three or four times this amount has actually been scrapped. In the present organization, Clayton R. Burt is vice-president and general manager; W. P. Kirk, general sales manager; David Ayr, factory manager; Frank O. Hoagland, in charge of engineering; Charles M. Pond, manager of the small tool division; W. H. Weingar, manager of the gage division; and A. H. d'Arcambal, sales manager of the small tool and gage divisions and consulting metallurgist for all divisions of the organization. The Pratt & Whitney Aircraft Corporation is affiliated with the Pratt & Whitney Co. Fred B. Rentschler is president of the Aircraft Corporation and George J. Mead, vice-president and director of the aircraft engineering work.

* * *

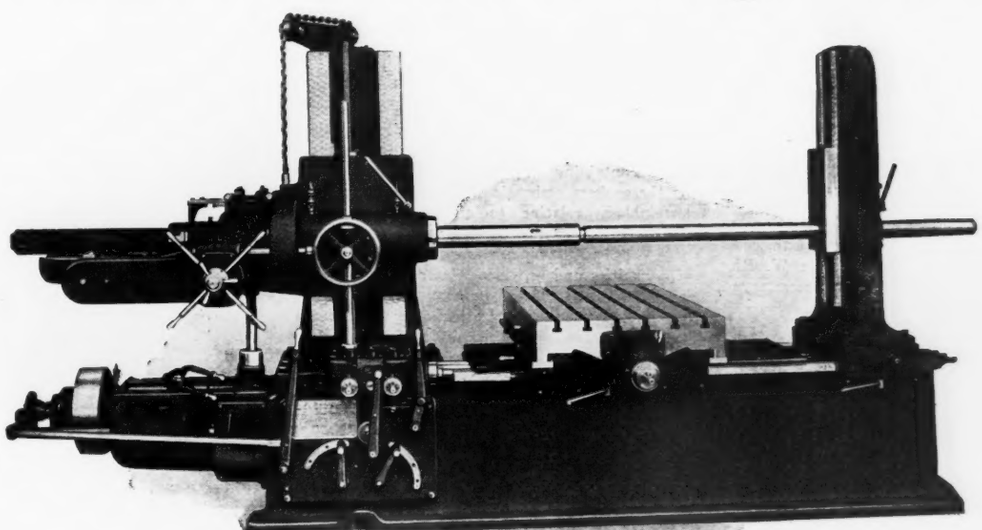
CHANGE OF BOOTH NUMBER AT ATLANTIC CITY EXHIBITION

After the advertisement of the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio, on page 160 of this number of MACHINERY was printed, information was received to the effect that the company's booth numbers at the exhibit of the Railway Supply Manufacturers' Association, to be held in Atlantic City June 9 to 16, have been changed from 168 and 170 to 947 and 949.

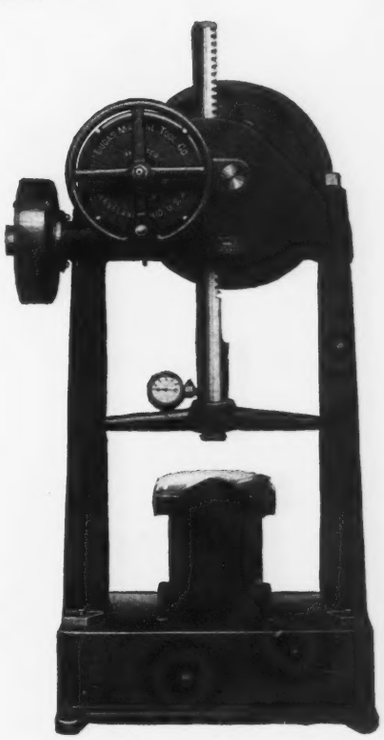
Modern Equipment Cuts Costs

It is sometimes astonishing to discover the obvious. One of our customers was astonished to discover that the job he had always been obliged to send to one of his neighbors who had an open side planer, could easily be done on his new

"Precision" BORING DRILLING & Milling Machine



There is no more "power" in a Press (or other machine) than is put into it. If the power is put in by hand, it is only one man power. In the



LUCAS
Power Forcing Press

the power is put in by belt or motor, but it has all the sensitiveness and delicacy of control of the best hand press, with the necessary power for heavy work.

If you attend the Railway Supply Manufacturers' Association Exhibition at Atlantic City, June 9th to 16th, be sure to look up our exhibit of both machines in spaces 843 and 845, Machinery Hall, across the Boardwalk from the Pier.

THE LUCAS MACHINE TOOL CO., Cleveland, Ohio, U. S. A.

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry, Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich. V. Lowener, Copenhagen, Oslo, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo. Ing. M. Kocian & G. Nedela, Prague.

COMING EVENTS

JUNE 1-4—Semi-annual meeting of the Society of Automotive Engineers at French Lick Springs, Ind. Coker F. Clarkson, 29 W. 39th St., New York City, secretary.

JUNE 9-16—Convention and exhibit of the Mechanical Division, American Railway Association, Young's Million Dollar Pier, Atlantic City, N. J. Secretary of the Mechanical Division: V. R. Hawthorne, 431 S. Dearborn St., Chicago, Ill. Secretary-treasurer of the exhibit: J. D. Conway, 1841 Oliver Bldg., Pittsburg, Pa.

JUNE 16-18—Thirteenth national convention of the Society of Industrial Engineers to be held at the Bellevue-Stratford Hotel, Philadelphia, Pa. The keynote of the convention will be "Practical Methods for Eliminating Waste." George C. Dent, executive secretary, 608 S. Dearborn St., Chicago, Ill.

JUNE 21-25—Twenty-ninth annual meeting of the American Society for Testing Materials at the Chalfonte-Haddon Hall Hotel, Atlantic City, N. J. Secretary's address, 1315 Spruce St., Philadelphia, Pa.

JUNE 28-JULY 1—Spring meeting of the American Society of Mechanical Engineers at San Francisco, Cal. Warren H. McBryde, California & Hawaiian Sugar Refining Corporation, 215 Market St., San Francisco, Cal., chairman of the local committee. Calvin W. Rice, 29 W. 39th St., New York City, secretary of the society.

JULY 1-SEPTEMBER 15—International Exhibition for Inland Navigation and Utilization of Hydraulic Power, at Basle, Switzerland. For further information apply to Organizing Secretary, International Exhibition, Basle V, Switzerland, or to the Swiss Federal Railroads, 241 Fifth Ave., New York City.

SEPTEMBER 2-3—Aeronautic meeting of the Society of Automotive Engineers at the Bellevue-Stratford Hotel, Philadelphia, Pa. Coker F. Clarkson, 29 W. 39th St., New York City, secretary.

SEPTEMBER 7-10—Machine tool exhibition in the Mason Laboratory, Sheffield Scientific School, Yale University, New Haven, Conn. H. R. Westcott, chairman, 400 Temple St., New Haven, Conn.

SEPTEMBER 20-24—Eighth annual convention and exposition of the American Society for Steel Treating to be held at the Municipal Pier, Chicago, Ill. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

SEPTEMBER 21-23—Production meeting of the Society of Automotive Engineers to be held at the Hotel Sherman, Chicago, Ill., simultaneously with the exposition of machine tools and heat-treating equipment sponsored by the American Society for Steel Treating. Coker F. Clarkson, 29 W. 39th St., New York City, secretary.

SEPTEMBER 27-OCTOBER 2—Annual convention of the American Foundrymen's Association and second international foundry congress in Detroit, Mich. In conjunction with these conventions there will be held an international exposition of foundry and machine shop equipment and supplies. C. E. Hoyt, secretary-treasurer, 140 S. Dearborn St., Chicago, Ill.

OCTOBER 2-10—Southern exposition to be held in the New Madison Square Garden, Eighth Ave. and 49th St., New York City. W. G. Sirrine, president of the exposition, New Madison Square Garden, New York City.

NOVEMBER 16-18—Transportation and service meeting of the Society of Automotive Engineers at the Copley-Plaza Hotel, Boston, Mass. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

DECEMBER 6-11—Fifth national exposition of power and mechanical engineering at the Grand Central Palace, New York City. Managers of the exposition: Charles F. Roth and Fred W. Payne of the International Exposition Co., Grand Central Palace, New York City.

SOCIETIES, SCHOOLS AND COLLEGES

MELBOURNE TECHNICAL SCHOOL, 124 Latrobe St., Melbourne, Australia. Prospectus for 1926 for the Working Men's College.

UNIVERSITY OF DELAWARE, Newark, Del. Annual catalogue for 1925-1926, containing calendar for 1926-1927, outline of courses, etc.

HEBREW TECHNICAL INSTITUTE, Stuyvesant and 9th Sts., New York City. Catalogue for 1926, containing calendar, outline of courses, etc.

OHIO MECHANICS INSTITUTE, Central Parkway and Walnut Sts., Cincinnati, Ohio. Circular announcing the summer session of the institute, which opens June 21 and closes July 30.

AMERICAN ARBITRATION ASSOCIATION, 342 Madison Ave., New York City. Pamphlet containing information on arbitration and its application in the settlement of disputes.

COMPRESSED AIR SOCIETY, 90 West St., New York City. Second edition of a pamphlet containing the trade standards adopted by the society, embracing the nomenclature and terminology relating to air compressors and their operation; a history of the development of speeds of air compressors; an explanation of capacities and pressures; instructions for the installation and care of air compressors; recommendations for the lubrication of air compressing machines and the cleaning of air receiver piping; a description of the low-pressure nozzle test recommended by the society; and a partial list of applications of compressed air.

NEW BOOKS AND PAMPHLETS

FLOW OF HEAT IN PISTONS. By H. A. Huebotter and G. A. Young. 119 pages, 6 by 9 inches. Published by Purdue University, Lafayette, Ind., as Bulletin No. 25 of the Engineering Experiment Station.

RESEARCH ASSOCIATES AT THE BUREAU OF STANDARDS. 20 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Circular No. 296 of the Bureau of Standards.

This circular outlines the plan for cooperative research work carried out by the National Bureau of Standards.

THE ENGINEERING INDEX FOR 1925. 792 pages, 6½ by 9½ inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York City. Price, $6 to members of the society; $7 to non-members.

This work is an index to articles published in the technical press, both in this country and abroad, during the year 1925, covering the field of mechanical, civil, mining, and electrical engineering. The present volume includes about 18,000 items, which are thoroughly cross-indexed, there being more than 3000 cross-references. An alphabetical list of the periodicals indexed is given at the beginning of the book. The articles are classified by subject, and in addition to giving the names of the articles and the periodical in which they appear, a brief resume of the contents is included. Attention is called to the fact that the Engineering Society's library will supply photostatic copies of any of the articles listed.

ENGINES OF HIGH OUTPUT. By Harry R. Ricardo. 110 pages, 5½ by 8½ inches. Published by MacDonald & Evans, 8 John St., Bedford Row, W.C. 1, London, England. Price, 7/6, net.

This book deals with the possibilities and limitations of high-speed gasoline engines. Since the war a great deal of research and development work has been carried out on this subject, and more detailed knowledge of the subject of combustion, the nature and behavior of various fuels, and the problems of lubrication are now available. This information is included in the present treatise, which deals particularly with the thermo-dynamic side of the problem, the intention being to supplement the present work with other volumes dealing with the mechanical side of the problem of high-speed engine design. The author has endeavored as far as possible to avoid introducing complicated mathematical calculations or formulas, the calculations being confined to simple arithmetic.

HUETTE TASCHENBUCH DER STOFFKUNDE (Huette Handbook of Materials). By the Academic Society Huette and Dr. A. Stauch. 1173 pages, 5 by 7¼ inches; 356 illustrations. Published by Wilhelm Ernst & Sohn, Berlin, Germany. Price, leather binding, 25.80 marks; cloth binding, 22.80 marks.

This is a specialized handbook relating to materials, following in size and arrangement the type of handbooks published by the Huette association, which justly rank as the leading engineering handbooks in the German language, and among the best publications of their kind in the world. The present handbook has every appearance of covering its field with the same completeness as the former handbooks issued by the association. It is divided into four main sections—chemistry, testing of materials, inorganic materials, and organic materials. Under each of these headings a complete and detailed treatment of all the phases of the subject is presented.

NEW CATALOGUES AND CIRCULARS

CIRCUIT BREAKERS. Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Publication 1643-A, describing the application of oil circuit-breakers.

MACHINE KNIVES. Henry Disston & Sons, Inc., Philadelphia, Pa. Catalogue describing the new Disston "A-1" knife and the "Lockweld" inlaid knife.

TIRE PUMPS. Bridgeport Brass Co., Bridgeport, Conn. Bulletin 23, covering tire pumps for automobiles, motorcycles, and bicycles; oil and grease guns; inflators, etc.

STEEL TIES. Carnegie Steel Co., Pittsburg, Pa. Catalogue of steel cross-ties for steam and electric railroads, mines, quarries, plantations, and portable tracks.

PYROMETERS. Brown Instrument Co., 4562 Wayne Ave., Philadelphia, Pa. Booklet containing instructions for the installation and care of thermo-electric pyrometers.

AUTOMATIC PRESSES. Baird Machine Co., Bridgeport, Conn. Circular illustrating Baird automatic presses, bench presses, tumbling barrels, and wire forming machines.

THRUST BEARINGS. Standard Steel & Bearings Inc., Plainville, Conn. Data sheets containing dimensions, list prices, and load ratings for M-R-C thrust bearings.

COUPLINGS. Smith Power Transmission Co., 1218 Ontario St., Cleveland, Ohio. Bulletin on "Flexoid" industrial couplings, giving dimensions, horsepower transmitted, etc.

BALL BEARINGS. New Departure Mfg. Co., Bristol, Conn. Sheet No. 171-FE for loose-leaf circular, descriptive of the application of ball bearings in temperature regulators.

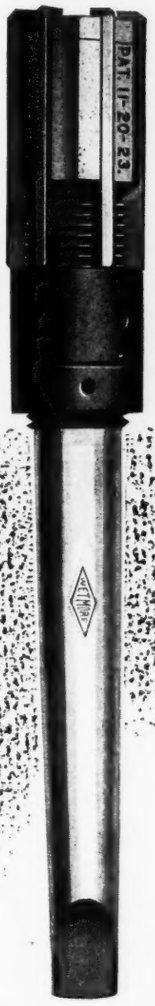
MILLING MACHINES. Kearney & Trecker Corporation, Milwaukee, Wis. Layout No. 17, illustrating the "hexing" of spark plugs on a No. 2B plain Milwaukee milling machine.

SPEED REDUCERS. Boston Gear Works Sales Co., Norfolk Downs, Mass. Leaflet descriptive of Boston adjustable speed reducers for universal use—in the store, factory or home.

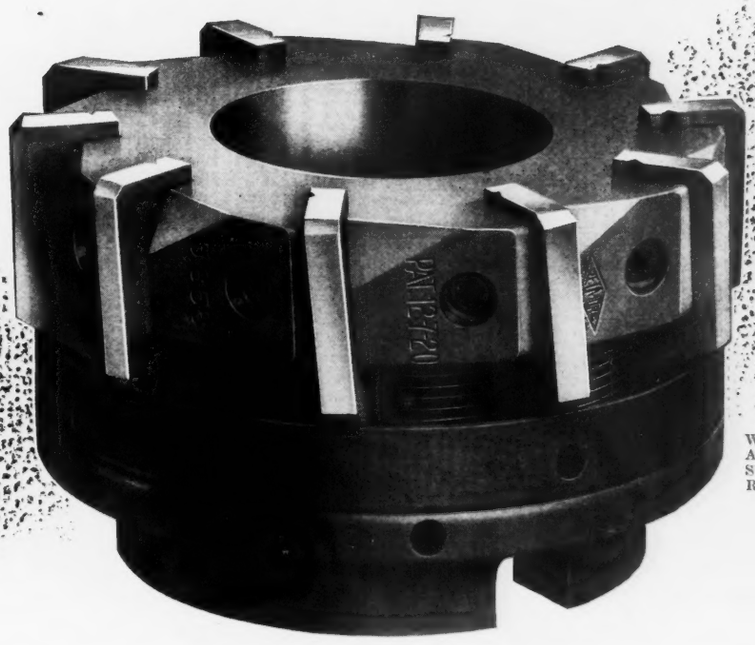
ELECTRIC DRAWING FURNACES. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Circular descriptive of the Homo electric drawing furnace, which is designed primarily to handle production quantities.

PNEUMATIC TOOLS. Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. Catalogue 15, covering the complete line

5/8" to 12"



Wetmore Adjustable Small Machine Reamers—⅝-in. to 31/32 in. straight or taper shank.



Wetmore Adjustable Shell Reamer.

—and any size in-between!

No matter how small or how large a reamer you need, get a ***Wetmore Adjustable Reamer.*** This famous reamer—now standard equipment in many of America's largest plants—ranges in size by thirty-seconds from ⅝ in. to 12 in. diameter. If the size you want isn't in stock, we will make it for you.

Here are four reasons why Wetmore Reamers cut production costs—do faster, more accurate work and stand up longer in service:

Adjustments to the thousandth of an inch can be made in less than a minute. In fact, the Wetmore is the quickest and easiest adjusting reamer made.

Solid, alloy steel body, heat-treated, guaranteed against breakage.

Left Hand Angle Cutting Blades that prevent digging in, chattering and scoring while backing out. Shearing effect of blades increases life of cutting edge.

No grinding arbor required for regrinding. Wetmore Reamers can be reground on their original centers.

NEW CATALOG

Write for Wetmore Catalog No. 26 of standard, heavy-duty, shell, small machine and cylinder reamers. Also arbors and replacement blades. *New, reduced prices.*

Let us prove these Wetmore advantages in your shop

WETMORE REAMER COMPANY
60-27th St., Milwaukee, Wisconsin

WETMORE ADJUSTABLE REAMERS
"THE BETTER REAMER"

of "Thor" pneumatic tools, including drills, hammers, grinders, hoists, and accessories.

MOTORS. General Electric Co., Schenectady, N. Y. Circulars GEA-6, GEA-71 and GEA-246, illustrating and describing, respectively, GE squirrel cage motors; wound rotor induction motors; and general-purpose synchronous motors.

REBUILT MACHINE TOOLS. J. L. Lucas & Son, Inc., Bridgeport, Conn. Lucas List No. 66 (supplementing catalogue 65), giving details concerning the rebuilt machine tools that this company now has in stock. Prices are included.

ELECTRIC CONTROLLING APPARATUS. Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis. Sheets for loose-leaf catalogue, covering manual starters, automatic starters, battery charging and testing equipment, and accessories.

VALVES. Homestead Valve Mfg. Co., Homestead, Pa. Catalogue 33, containing principal dimensions and price list covering the line of Homestead valves for water, air, steam, acids, oil, heavy liquids, etc. Copies will be sent to those interested upon request.

HIGH-SPEED SAWS. Hunter Saw & Machine Co., 5662 Butler St., Pittsburg, Pa. Circular 18, illustrating and describing the Hunter model 1-A high-speed metal cut-off saw. The circular gives complete specifications, including the cutting time on different classes of work.

CARBONIZING MACHINES. American Gas Furnace Co., Elizabeth, N. J. Circular illustrating American rotary gas carbonizing machines in use carbonizing Timken roller bearings. The circular outlines how carbonizing costs may be reduced by installing these machines.

ELECTRIC TRUCKS. Graham Bros., Detroit, Mich. Catalogue of electric trucks, containing facts intended to guide manufacturers in their selection. The catalogue shows different types of Graham trucks, and reproduces letters of recommendation from users, as well as a partial list of users.

STEAM METERS, PYROMETERS, AND CARBON DIOXIDE RECORDERS. Republic Flow Meters Co., 2240 Diversey Parkway, Chicago, Ill. Catalogue S-33, entitled "Steam Economy," treating of methods for reducing steam costs, and illustrating electrically actuated meters of the indicating and recording type.

RIVETED JOINTS. Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill. Bulletin 940, discussing the relative merits of riveted and electrically welded joints in structural steel construction, boilers, cooling tanks, and similar apparatus. The bulletin quotes a number of authorities on this subject.

STEEL RIVETED BOILERS AND TANKS. Kewanee Boiler Co., Kewanee, Ill. Circular illustrating Kewanee steel riveted heating boilers. Bulletin 940, containing the reprint of a letter from the Hanna Engineering Works relating to the comparative advantages of welded and riveted tanks and boilers.

OIL ENGINES. Ingersoll-Rand Co., 11 Broadway, New York City. Circular entitled "Direct Injection Oil Engines for All Purposes," containing technical data and details concerning Ingersoll-Rand PO oil engines. The circular contains illustrations of plant lay-outs, installation views, diagrams, and engine details.

TAPER PIN REAMER. Gammons-Holman Co., Dept. M., Manchester, Conn. (sales agent, Commercial Tool Co., 2026 E. 22nd St., Cleveland, Ohio.) Circular descriptive of the Gammons taper pin reamer designed to be used in a drill press or in an electric or air drill, for reaming holes for standard taper pins. Dimensions and prices are included.

PYROMETERS. Brown Instrument Co., 4435 Wayne Ave., Philadelphia, Pa. Catalogue 15, containing information on recent developments in pyrometry. The complete line of Brown pyrometers is illustrated and described, as well as thermo-couples, protecting tubes, switches, and other accessories. Prices of the various instruments are included.

NON-METALLIC GEARS. Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Publication F-4506-B entitled, "Salient Facts on Silent Gears," containing information on "Micarta" gears. The data presented is in accordance with the recommendations of the American Gear Manufacturers' Association. The folder contains a number of formulas and tables and describes the applications of these gears.

AUTOMATIC DIE-CUTTING MACHINES. Keller Mechanical Engineering Corporation, 70 Washington St., Brooklyn, N. Y. Pamphlet describing in detail the Keller automatic type BL tool-room machine, which is designed to meet all the requirements of the die- and tool-room and the metal pattern shop. The circular contains illustrations showing various operations in die- and tool-making being performed on this machine.

TURRET LATHES. Warner & Swasey Co., Cleveland, Ohio. Book II of a series on "Modern Tooling Methods for Turret Lathes." This book deals with chuck work and suggests methods for increasing production on chucking work. This subject will be dealt with in two books, the third books in the series giving further examples of chuck tooling. The present book is divided into five sections treating of the Problems of Chuck Work; Choice of Machine; Holding Devices; Order of Operations; and Typical Chucking Set-ups.

BALANCING MACHINES. Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis. Treatise entitled "Dynamic Balancing Simplified," containing information on the general subject of balancing, as well as descriptions and illustrations of Gisholt precision balancing machines. The contents include: Some General Considerations in Relation to Dynamic Balancing; Measuring and Correcting Dynamic Unbalance; Order of Operation; Determining the Calibration Constant; Calculating Rule; and Recording Amplimeter.

BLUEPRINTING MACHINERY AND DRAFTING-ROOM SUPPLIES. C. F. Pease Co., 822 N. Franklin St., Chicago, Ill. Catalogue G, covering the complete line of products made by this company, which includes blueprinting machinery, blueprint paper and lamps, photographic arc lamps, drafting-room supplies and furniture, drawing instruments, and surveying instruments. The book is arranged with a thumb-index for convenience in referring to the various sections. Price list and discount sheet are included. Those interested can obtain copies of this catalogue upon request.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

of MACHINERY, published monthly at New York, N. Y., for April 1, 1926,

State of New York } ss.
County of New York }

Before me, a Notary Public, in and for the state and county aforesaid, personally appeared Edgar A. Becker, who, having been duly sworn according to law, deposes and says that he is the treasurer of the Industrial Press, Publishers of MACHINERY, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Industrial Press, 140-148 Lafayette St., New York; Editor, Erik Oberg, 140-148 Lafayette St., New York; Managing Editor, None; Business Managers, Alexander Luchars, President, 140-148 Lafayette St., New York, and Robert B. Luchars, Vice-president, 140-148 Lafayette St., New York.

2. That the owners of 1 per cent or more of the total amount of stock are: The Industrial Press; Alexander Luchars; Alexander Luchars, Trustee for Helen L. Ketchum, Elizabeth Y. Urban, and Robert B. Luchars; Matthew J. O'Neill; Louis Pelletier; and Erik Oberg. The address of all the foregoing is 140-148 Lafayette St., New York.

3. That there are no bondholders, mortgagees, or other security holders.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

EDGAR A. BECKER, Treasurer

Sworn to and subscribed before me this 24th day of March, 1926.

CHARLES P. ABEL,

(SEAL) Notary Public, Kings County No. 153
Kings Register No. 7006
New York County No. 49. New York Register No. 7082
(My commission expires March 30, 1927.)

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FOUNDRY APPRENTICE CONTEST IN DETROIT

An annual contest for foundry apprentices has been announced by the apprentice committee of the American Foundrymen's Association. The first contest will be concluded at the Detroit meeting of the association this fall, September 27 to October 2. The plans include local contests in different cities, with apprentices divided in groups according to whether they are engaged in gray iron, steel, or brass foundry work. The castings of the winning apprentices in each local group are to be sent to the annual convention of the American Foundrymen's Association and are there to be judged in competition with those from all other local contests. Prizes for the winners at the national meeting are to be provided by the association. Any foundry wishing to have its apprentices enter into this contest should communicate with the secretary of the American Foundrymen's Association, C. E. Hoyt, 140 S. Dearborn St., Chicago, Ill.